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ENVIRONMENTAL ANALYSES IN THE KOOTENAI RIVER REGION, MONTANA

H.L. McKim, L.W. Gatto, C.J. Merry,
B.E. Brockett, M.A. Bilello,
J.E. Hobbie and J. Brown

November 1976

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The purpose of this investigation was: 1) to compile and analyze climatic data for the past 10 years from all available weather observing stations in the East Kootenai River Basin, 2) to analyze changes in ice and snow cover, and turbidity and plankton blooms on Lake Koocanusa, 3) to assess the present limnology of Lake Koocanusa and the potential for water quality problems, especially eutrophication, and 4) to demonstrate the reliability of the LANDSAT Data Collection Platform (DCP)-Martek Water Quality Monitor system for acquisition of data from a remote site. Results of the investigations indicate that the Kootenay region is about twice as cold as the Libby region in winter, and that reservoir ice first forms along the shore in the northern region in late November and in the southern part in

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mid-December, with total freeze-over usually occurring 2 to 4 weeks later. Ice break-up in the northern sections usually occurs 1-3 weeks later than in southern areas; average annual snowfall is 42 to 144 in., with ice thickness and snowfall varying with relief. Variations in areal distribution of snow within the basin and ice cover on the reservoir were observable for periods from January to October 1973, and reservoir turbidity was observed to increase south of Ellsworth and Stenerson Mountains. Low algal productivity observed was due to the algae being circulated most of the time below the depth of 1% light and due to high turbidity. The DCP-Martek system operated well and reliable data were received while the system was located in the pool above Libby Dam and downstream below the dam. Brief interruptions in data transmissions occurred in April, when the Martek sensor showed a few minor inconsistencies, but the system demonstrated the feasibility of this technique for data acquisition from remote sites.

PREFACE

This report was prepared by Dr. H.L. McKim, Chief, L.W. Gatto, Geologist, C.J. Merry, Geologist, and B.E. Brockett, Physical Sciences Technician, of the Earth Sciences Branch, Research Division, by M.A. Bilello, Meteorologist, of the Snow and Ice Branch, Research Division, by Dr. J.E. Hobbie, Expert, and by Dr. J. Brown, Research Soil Scientist, also of the Earth Sciences Branch, Research Division, U.S. Army Cold Regions Research and Engineering Laboratory. The studies described in this report were supported with the following funds: Seattle District Reimbursable Order 74-051, Corps of Engineers Civil Works Project 31111, *Environmental Criteria for Resource Management in Cold Regions*, and NASA LANDSAT-1 Project 4-70253, *Arctic and Subarctic Environmental Analyses Utilizing LANDSAT-1 Imagery.*

The authors express appreciation to the following personnel at the U.S. Army Engineer District, Seattle: Norman J. MacDonald and Roger L. Ross for assistance in planning the project, Ron Bush and Dr. Stephen Dice, for assistance throughout the project and Tom Bonde, dam keeper at Libby Dam, for assistance in scheduling the boat and in conducting the field work. Appreciation is also given to David Penick, Office, Chief of Engineers, for providing the LANDSAT-1 imagery, Margot Nelson for determinations of snow cover, Ray Tuinstra, CRREL, for conducting field tests on the data collection system, and Eleanor Huke, CRREL, for preparation of the illustrations.

CONTENTS

SUMMARY

This report presents a series of observations and analyses of data obtained in conjunction with CRREL projects on the environmental analyses of reservoirs in cold regions. The capability to forecast reservoir and river water quality under conditions of extended snow and ice covers is a relatively new challenge to the operations of reservoirs in cold regions. The Libby Dam project was selected by CRREL environmental scientists as an appropriate site to develop a better understanding of cold region problems present in reservoirs and to assist the Seattle District in analyzing existing data bases.

The objectives of the CRREL/Seattle District cooperative Libby Dam project were to:

1) assess seasonal variation in turbidity and possible plankton blooms; identify the duration and extent of ice cover of Lake Koocanusa from presently available satellite imagery; evaluate the extent of snow cover in the surrounding basin from satellite imagery.

2) assess the potential for water quality problems, especially eutrophication, from water quality data collected or supplied by the Seattle District.

3) explore the feasibility of continuously monitoring the Libby Dam discharge for nitrogen supersaturation and the possibility of interfacing the active sensor(s) or transducer(s) with ERTS satellite data collection platforms.

4) explore the interfacing of other promising sensors and continue the operation of the ERTS data collection platform during the spring runoff into summer.

Part I of this report was accomplished as a portion of the CRREL Civil Works Program and was useful as ground truth data in Part II. Objectives 1, 2 and 4 are addressed in Parts II, III and IV of this report. Objective 3 is addressed in a separate report entitled "Continuous monitoring of total dissolved gases in natural waters, A feasibility study" by Thomas F. Jenkins, CRREL Special Report 231, May 1975.

PART I. SNOW, ICE AND WINTER TEMPERATURES IN THE EAST KOOTENAI RIVER BASIN

Michael A. Bilello*

Introduction

The purpose of this part of the study was to compile and analyze climatic data for the past ten years from all available weather observing stations in the East Kootenai River Basin. This basin is located in western Montana and southeastern British Columbia, Canada, and is the drainage basin for Lake Koocanusa, an artificial lake formed by Libby Dam. Location of the stations used in the study is shown in Figure 1; the monthly climatic summaries for October through April 1963-64 to 1972-73 are given in Appendix I, and these data were obtained from various U.S. and Canadian sources (Ref. 1-5).

The primary objectives for collecting and analyzing these climatic statistics were to: 1) obtain the most recent period of record, 2) obtain concurrent records for all stations to make comparisons possible, 3) obtain maximum coverage of available weather data within the basin, 4) list year to year observed values in order to extract extreme events, 5) obtain detailed information on the air temperature regime in order to estimate the seasonal ice conditions on the reservoir and rivers in the basin, and 6) compile information on snowfall amounts and snow depths to evaluate probable snow conditions in the basin.

Winter temperature regime

A summation of the average monthly temperatures for 1) 10 years of record and 2) the coldest winter observed between 1963 and 1973, for seven of the stations studied, are given in Appendices IIA and IIB, respectively. Libby, the first station on the list, is at the southern end of the basin and Kootenay† is the most northern station. The other stations given in Appendices IIA and IIB were selected to show the variations in the winter temperatures between these two locations.

As might be expected, there is a definite trend toward colder winters from south to north in the basin. Summations of total freezing degree days indicate that the region near Kootenay is about twice as cold as the Libby region in winter. The coldest winter between 1963 and 1973 in the area occurred in 1968-69, and the summation of freezing degree days again shows the north-south difference in temperature.

Onset of lake and river freezing

According to the model developed by Chen and Orlob[6] it is estimated that ice would form on Lake Koocanusa in late November or early December. In the model it was assumed that ice would form soon after the water in the lake reaches the point of maximum density at the temperature of 4°C (39.2°F). However, earlier studies on temperature measurements made in lakes prior to freezing have shown that the body of water will cool at depth to temperatures much lower than 4°C before freezing begins.[7, 8] Consequently, although it does appear that throughout most of the basin the bodies of water will cool to 4°C by

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** Meteorologist, U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire 03755.*

† This spelling is used for Canadian locations.

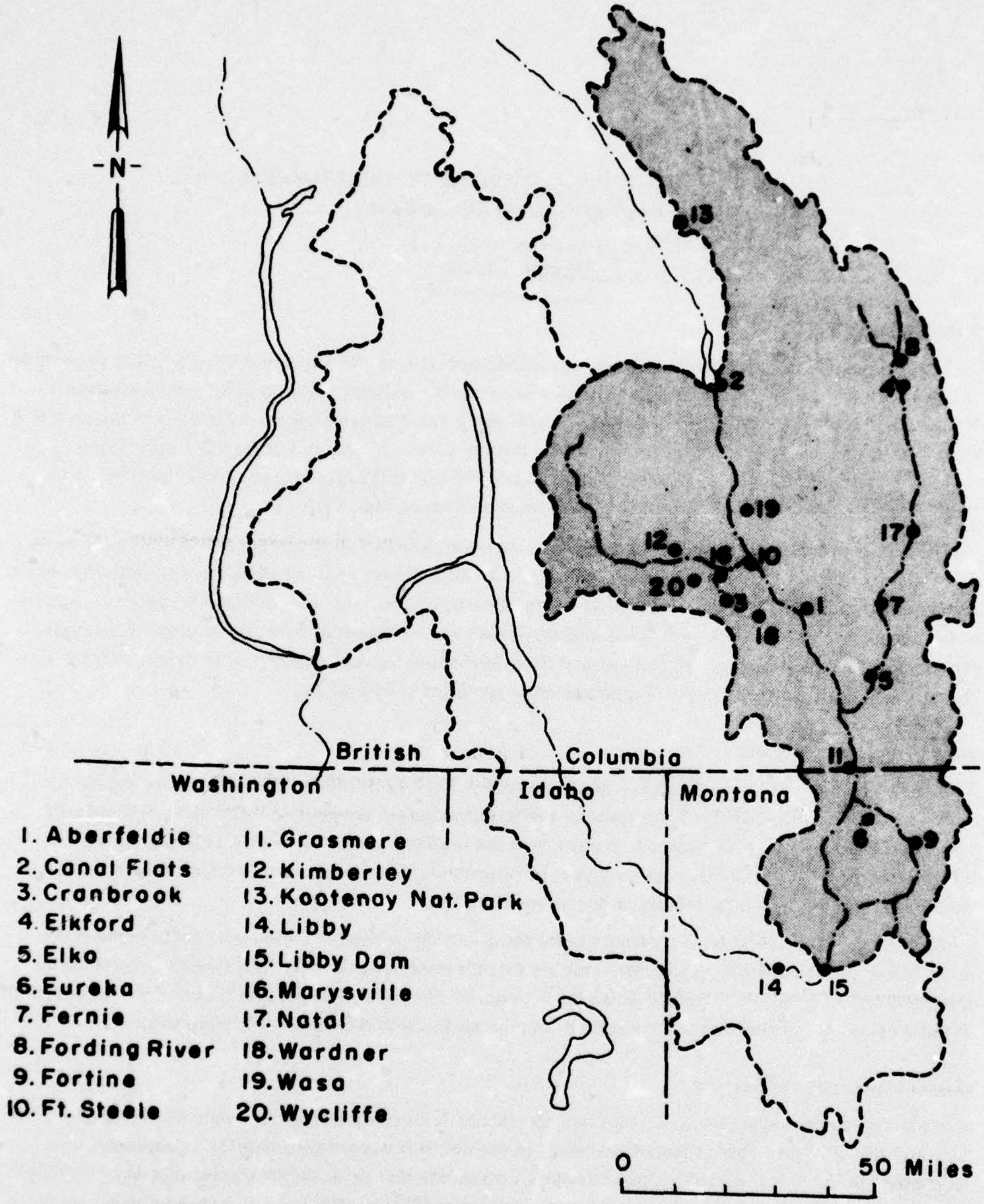

Figure 1. Station locations in the East Kootenai River Basin.

the end of November or early December, surface ice formation will probably be delayed. It should be kept in mind, also, that many other important aspects need to be considered when predicting first-ice formation and subsequent freeze-over. Some of these factors are: 1) the speed of moving water, 2) the depth and width of the water, 3) the fact that shore ice will form first, but shore to shore coverage is often delayed considerably and may not occur during milder winters, 4) the significant variations in the severity of the winters,

which can be expected both regionally and from year to year, and 5) the influence of snow on the ice. Snow is important for two reasons: first it acts as an insulator, thus preventing rapid ice growth during cold periods, and second it leads to the formation of "snow-ice." This latter phenomenon can quickly convert 1 ft of "dry" snow to 4 to 8 in. of white (or bubbly) ice, which is generally known as snow-ice.

Based on previous experiences the author would speculate that, on the average, shore ice (in the shallow, quiet areas) would form first in the northern part of the basin during late November, and in the southern part during mid-December. Freeze-over then would occur 2 to 4 weeks later, except in faster moving water and/or in deeper areas where complete ice coverage would be further delayed. The influence of the snow-cover and variability in the severity of each winter will naturally complicate attempts to predict ice growth.

Maximum ice thickness

The thickest ice will probably be formed in the shallow, quiet and/or blocked tributary waters in the upper part of the basin. The ice cover in these areas could get to be 2 to 3 ft in thickness during the colder winters. The area under study also seems to be affected by major winter thaws. If so, then ice jams may occur in the lower reservoir if the level of water increases and the flow becomes sufficient to break and move the ice. Under such conditions, it is possible that the Lake Koocanusa reservoir would become a jumble of ice, particularly in spring during some years. In the southern region of Lake Koocanusa, ice buildup near shore could reach 2 or 2½ ft during colder winters, but in the center of the lake it seems unlikely that the ice would reach thicknesses much over 1 to 1½ ft, and a good deal of it would be in the form of snow-ice. Some winters such as 1973–74 may be mild enough to keep some or all areas open all winter.

Onset of break-up

According to the model developed by Chen and Orlob,[7] ice deterioration begins about 15 March and the ice is gone by 15 April. The summation of average monthly temperatures shown in Appendix IIA indicates that these estimated dates of ice breakup and disappearance are quite good. Since the southern regions of the basin warm sooner in spring, and because ice conditions are probably more severe in the northern regions, it is estimated that breakup occurs from 1 to 3 weeks later in the northern sections.

Maximum snow cover

The three U.S. stations located in the basin (Libby, Fortine and Eureka) provided good records of snowfall amount and snow depth on the ground. Five of the Canadian stations in the basin (Grasmere, Cranbrook, Kimberley, Wasa and Kootenay) provided only fair snowfall and snow depth records. The snow information compiled for these stations is given in Appendix III. The observational procedures followed by the U.S. and Canada are similar, except that the U.S. reports the maximum depth of snow on the ground for the month, whereas the Canadians report the depth of snow on the ground at the end of the month. Also, some instruments in Canada immediately melt the fallen snow, and a ratio of 10 to 1 is used to determine snowfall amounts from the observed water equivalent values. This ratio, however, is not always correct.

The following snowfall and snow depth data, compiled for the above eight stations, are shown in Appendix III: 1) average snowfall amount, 2) maximum snowfall amount, 3) minimum *annual* snowfall amount, 4) maximum *monthly* snowfall amount, 5) highest monthly average depth of snow on the ground, and 6) highest maximum depth of snow on the ground. The results show a range in average annual snowfall amounts of from 42 to 144 in. in the basin over the 10-year record. The two stations which average over 75 in. per year (Kimberley and Cranbrook) are located near each other in the west central part of the basin (Fig. 1). The lowest annual snowfall amount (29 in.) was reported at Grasmere in 1969–70, and the highest annual snowfall amount (216 in.) was observed at Kimberley in 1971-72. Maximum monthly amounts range from about 27 to 68 in. and occur in December, January or February. Snow depth each month averages from 11 to 28 in., but reached maximum depths of 30 to 40 in. during some months at some sites. It should be kept in mind, however, that the region under study contains some rugged terrain, and snowfall and snow depths (due to drifting) could be appreciably different from place to place throughout the basin.

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II. LANDSAT-1 IMAGERY EVALUATION

Harlan L. McKim,* Lawrence W. Gatto* and Carolyn J. Merry*

Introduction

LANDSAT-1,† a modified Nimbus satellite was launched aboard a two-stage Delta rocket from the Western Test Range, Lompoc, California, on 23 July 1972. The satellite circles the earth in a 920-km (572- statute mile) near-polar orbit once every 103 minutes, completing 14 orbits per day and viewing the entire earth every 18 days (Fig. 2). The orbit characteristics permit repetitive image acquisition of any given area in the world at the same local time every 18 days. Initially two imaging systems, a return beam vidicon (RBV) and a multispectral scanner (MSS), provided photographic images of an area approximately 185 km (100 nautical miles) on a side.

The methods of operation of the RBV and MSS are different. The RBV is actually a camera without film. When the shutters of the three RBV cameras open, images are stored inside each of the three vidicon camera tubes and then scanned to provide a video picture. The cameras are shuttered every 25 seconds to produce overlapping pictures. During the 149th orbit the RBV system malfunctioned and on 6 August 1972 the tape recorder for this system was deactivated. The MSS produces images by breaking a scene into many tiny segments. The segments are obtained in rapid succession by means of a scanning mirror in the optical system. The standard data product from either system is a black and white image for the seven spectral bands, three bands from the RBV and four from the MSS. The LANDSAT-1 MSS imagery, spectral bands 4 (.5-.6 μm, blue-green), 5 (.6-.7 μm, yellow-red), 6 (.7-.8 μm, near IR) and 7 (.8-1.1 μm, near IR), was utilized in this investigation.

Previous studies[1] have shown that the resolution of the LANDSAT-1 imagery will allow identification of circular water bodies approximately 152 m (500 ft) in diameter; however, smaller water bodies can be identified in certain LANDSAT-1 scenes if there is significant contrast between adjacent features. Linear features, such as streams, power transmission lines and road networks, 70 m in width are readily discernible. Snow patches and forest clearings as small as 6 acres can be identified, although areas smaller than 12 acres cannot be mapped accurately on the standard 7.3- x 7.3-in. data products.

Site selection and objectives

Personnel from the Environmental Resources Section, Corps of Engineers, Seattle District and CRREL Earth Sciences Branch selected the Libby Dam (1)-Lake Koocanusa (2) area in the Kootenai River (3) Basin in Montana (Fig. 3) as a test site to demonstrate the utility of LANDSAT-1 imagery in certain Corps of Engineers reservoir management tasks. The area of interest is that portion of the basin between Libby (4) on the south and Eureka (5) on the north, and the Purcell Mountains (7) on the west and the Salish Mountains (8) on the east. The Whitefish Mountains (9) and Glacier National Park (6) are located east of the study area.

** Research Soil Scientist and Geologists, respectively, U.S. Army Cold Regions Research and Engineering Laboratory.*

† Earth Resources Technology Satellites (ERTS) have been renamed LANDSATs.

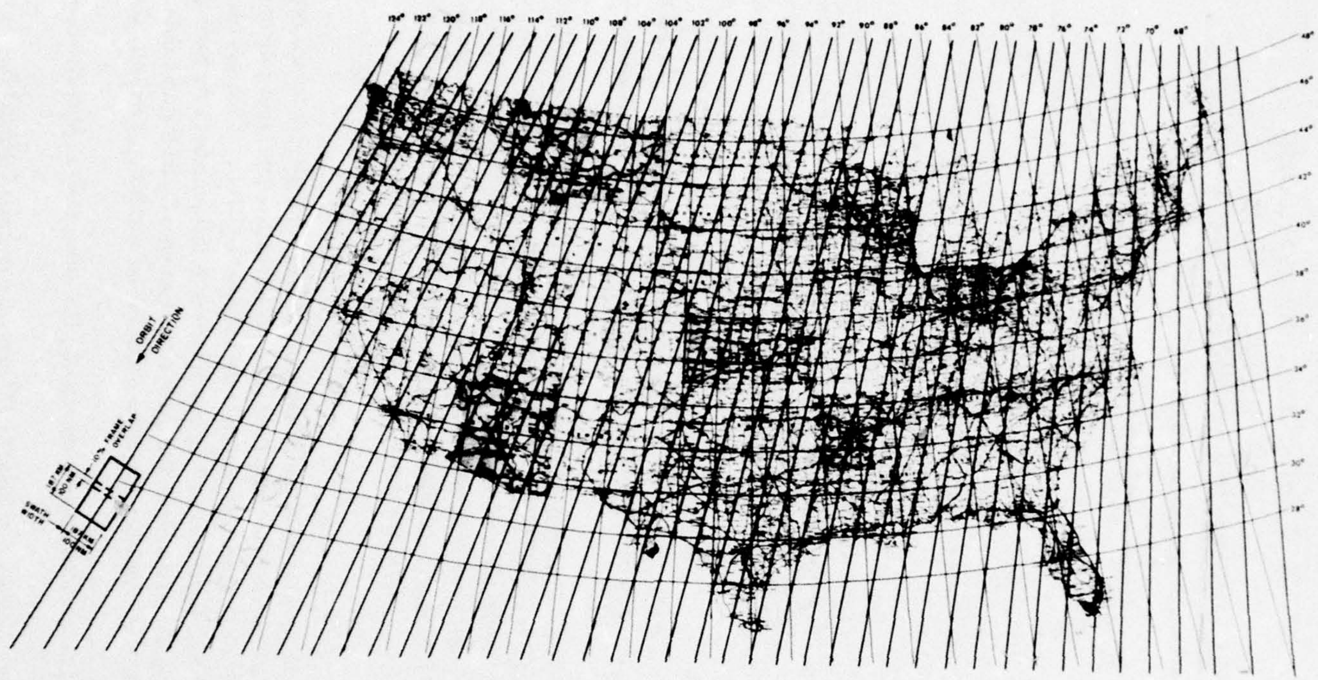

Figure 2. LANDSAT-1 ground track locations (provided by General Electric Co.).

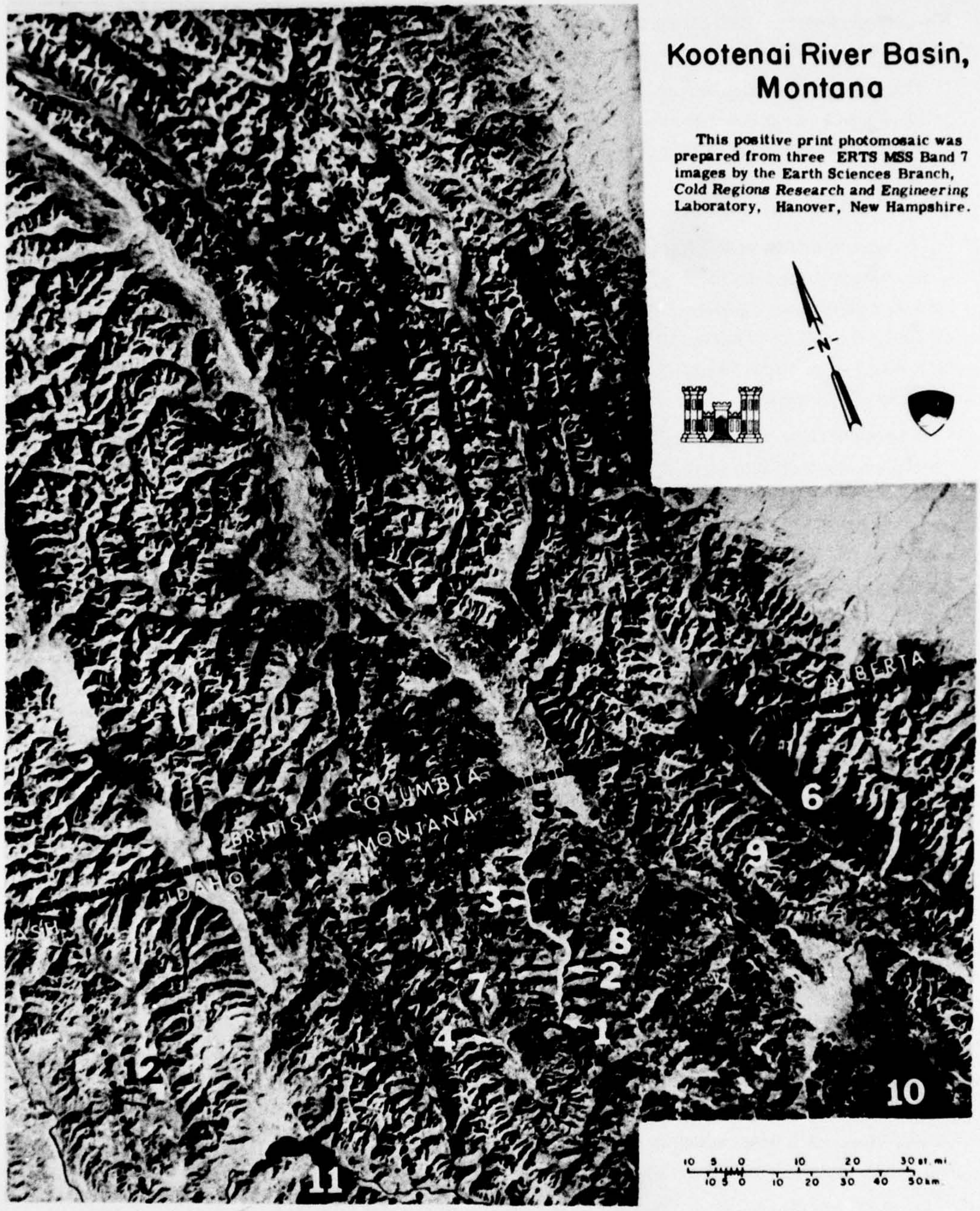

Figure 3. Lake Koocanusa (2) in the Kootenai River (3) Basin, Montana; image numbers are 1199-18032, 1200-18084 and 1200-18091; acquired on 7 and 8 February 1973; approximate location of US-Canada border, Flathead Lake (10), Pend Oreille Lake (11), Priest Lake (12) and Kootenay Lake (13).

One task of the study was to assess seasonal variations of turbidity and plankton blooms in Lake Koocanusa, the reservoir formed by Libby Dam. The objectives for this part of the Libby Dam investigation were to use LANDSAT-1 imagery for the following:

1) to identify the duration and the extent of ice and snow cover
2) to assess seasonal variations in turbidity and plankton blooms
3) to identify sources of turbidity and areas of plankton concentration.

Methods of analysis

Negative transparencies (70-mm format) of 34 selected LANDSAT-1 images were acquired in early April 1974. Many of these images had extensive cloud cover and most of the land surface was obscured. Snow, ice and turbidity were apparent, however, in six images acquired on 2 January, 8 February, 3 April, 11 and 29 September and 17 October 1973. Positive prints and transparencies of the four MSS spectral bands of each image were utilized in the analysis, although bands 5 and 7 were most useful for mapping snow, ice and water/land boundaries.

A Spectral Data Multispectral Viewer was used to make false color enhancements of snow cover, ice conditions and turbidity identified on MSS bands 5 and 7 positive transparencies. Various combinations of colored filters and light intensities were tested on the viewer to identify the combination that produced the best enhancement of these specific features. In addition, black and white enlargements were made of the band 5 and 7 images for the six LANDSAT-1 scenes. Land/water boundaries and the ice/water/turbidity boundaries were delineated from these images on transparent overlays. Band 7 images were the most useful in delineation of water/land boundaries. Very little near infrared radiation is reflected by water. This results in the characteristic black tone of water on these scenes.

Results

Clouds (1) covered over 50% of the Kootenai River Basin but a large portion of the river channel is visible on the LANDSAT-1 band 5 scene acquired on 2 January 1973 (Fig. 4a). The southern portion of the reservoir north of the dam (9) is completely ice-covered (2). Cloud and mountain shadows (4 and 5) cause the ice cover to appear light gray in the following areas: north of the dam to Warland Creek (7), on the eastern bank of the Kootenai River from Stenerson Mountain (6, under clouds) south to Warland Creek and along the western bank southwest of McGuire Mountain (8, under clouds). At the northern end of the reservoir, the Kootenai River flows through a relatively narrow, ice-free channel (3).

On 8 February 1973 (Fig. 4b), Lake Koocanusa and the Kootenai River were still ice-covered except for the narrow ice-free river channel in the northern portion of the reservoir. Snow-covered, clear-cut areas (1) are scattered throughout the mountains bordering the reservoir. Extensive snow cover was observed in the lowlying areas near Libby (4) and Eureka (2) in the northern portions of this 8 February scene. Therefore, the snowline at this time lies well below the lowest elevation at Libby Dam (3000 ft mean sea level). Climatological data have confirmed this observation. Vegetation (3) in the mountainous areas south of Eureka shows dark tones which indicates that vegetation can mask the extent of snow cover; the vegetation in the mountainous area (5) north of Eureka is snow-covered.

Snow (1) can also be observed at the higher elevations in the Kootenai River Basin on 3 April 1973 (Fig. 5a). Between 8 February (Fig. 4b) and 3 April (Fig. 5) snowmelt was rapid and the snowline rose significantly. On the 3 April scene snow occurred at or above elevations greater than 4,000 ft, except for a few isolated patches of snow (on north-facing slopes west of Lake Koocanusa) at elevations ranging from 3200-3400 ft. The differentiation between snow and clouds becomes more difficult under dense cloud cover (6). Most of the river ice had melted in the immediate reservoir area (Fig. 5b). The tonal contrast between the river and the land is very clear in this band 7 image. The light gray border along the river (2) (Fig. 5a) is the reservoir bottom exposed when the water level is lowered in preparation for spring runoff. South of Ellsworth (3) and Stenerson (4) mountains the turbidity (5) in the reservoir increases significantly.

Figure 4a. Ice-covered Lake Koocanusa; enlarged portion of LANDSAT-1 band 5 image 1163-18031, acquired 2 January 1973.

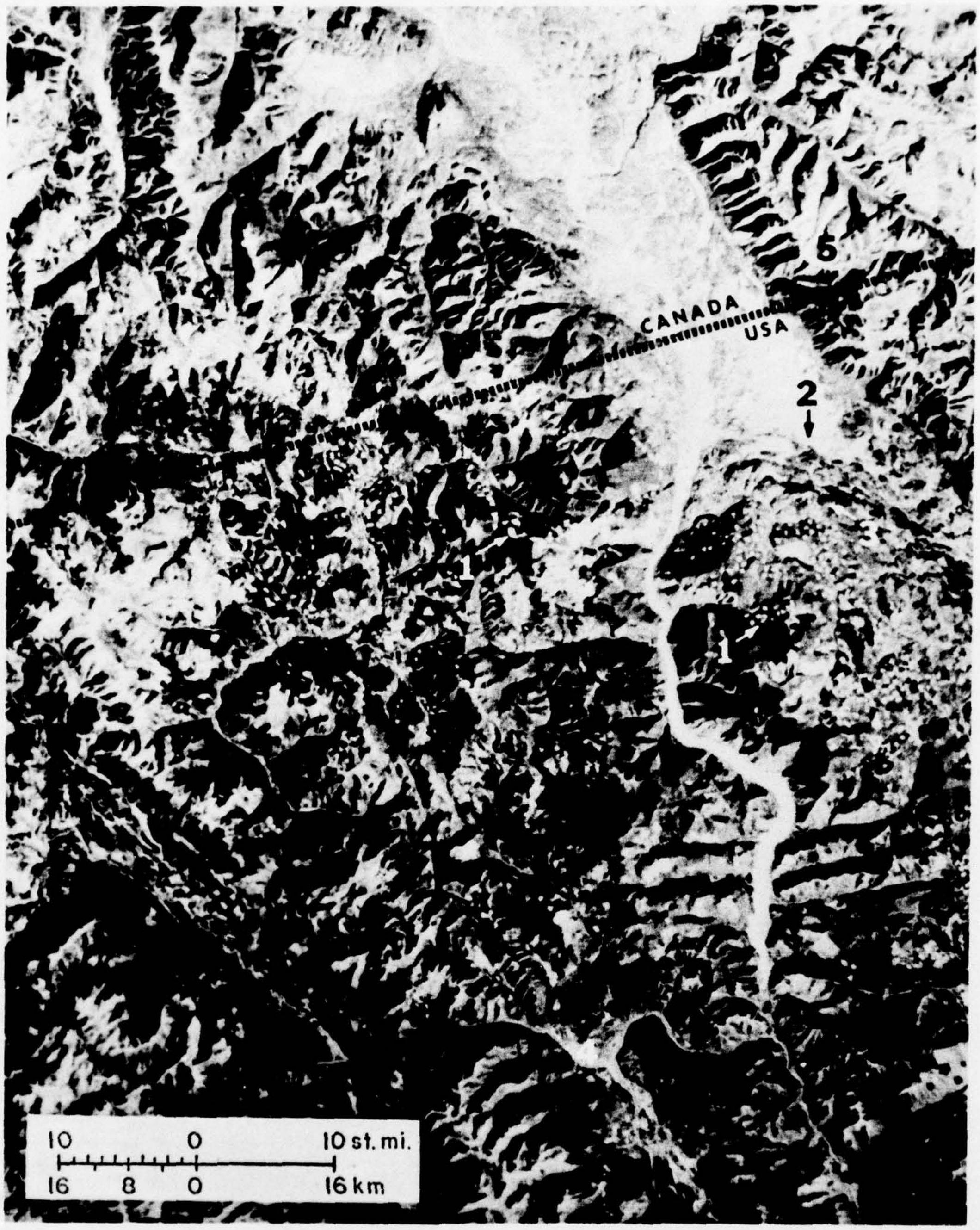

Figure 4b. Ice-covered Lake Koocanusa; enlarged portion of LANDSAT-1 band 5 image 1200-18091, acquired on 8 February 1973.

Figure 5a. Snow-capped mountain peaks below thin stratus clouds (7); enlarged portion of LANDSAT-1 band 5 image 1251-18093, acquired 3 April 1973.

Figure 5b. Band 7, near-IR, image of same scene as Fig. 4a.

Figure 6a. Lake Koocanusa; enlarged portion of LANDSAT-1 band 5 image 1415-18051, acquired on 11 September 1973.

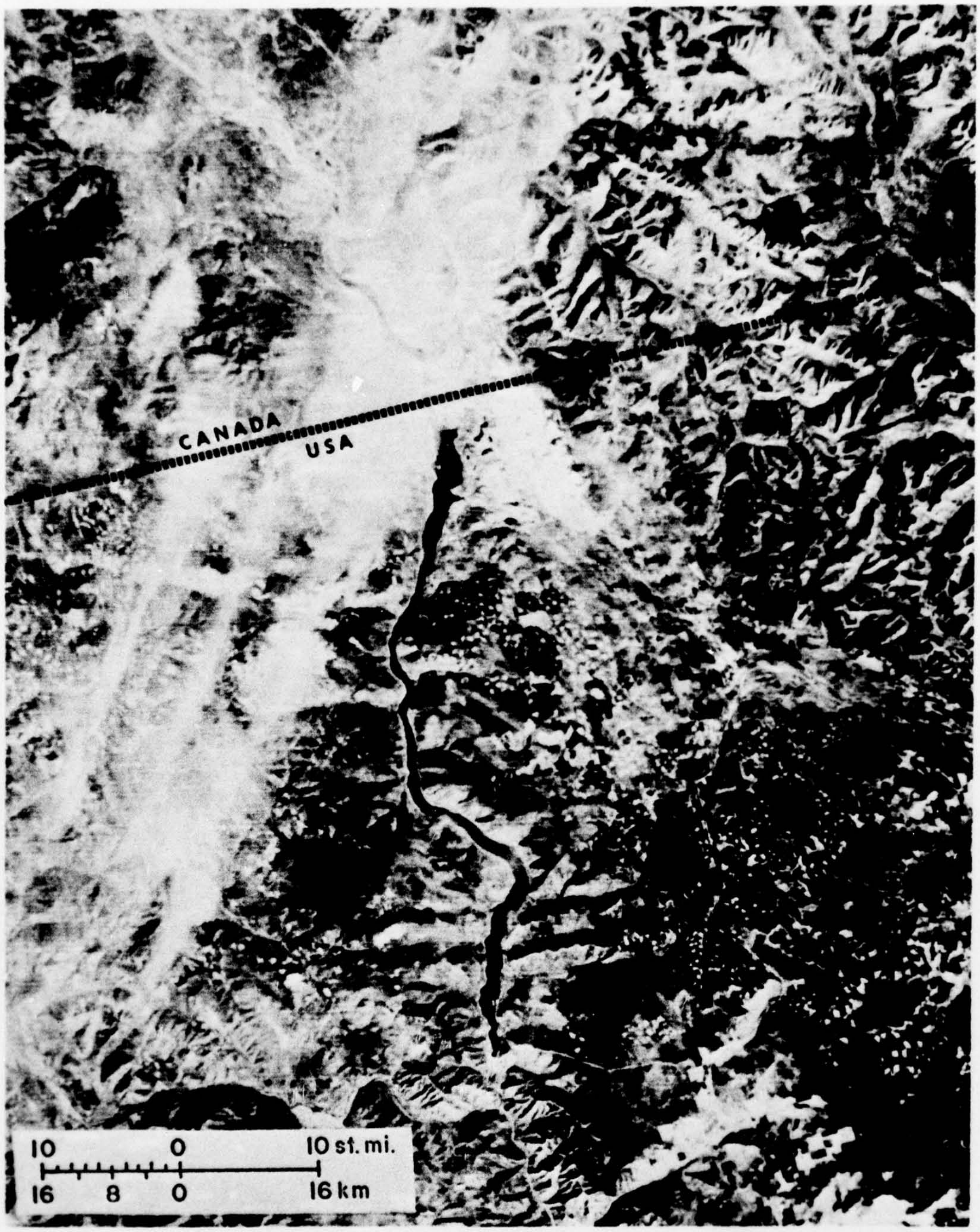

Figure 6b. LANDSAT-1 band 5 image 1433-18012; acquired on 29 September 1973.

Figure 6c. LANDSAT-1 band 5 image 1451-18010, acquired on 17 October 1973; locations where snow data in Table 1 were taken: Bristow Creek (2), Lost Soul (3), Banfield Mountain (4), Red Mountain (5), and Stahl Peak (6).

Table 1. Areal snow distribution and snow pillow data for the Kootenai River Basin, Montana.

a. Snow water content and inches of snow, 1973.

Bristow Creek (3,900')	Jan 10	4.3" (16" snow)	Mar 1	8.3" (22" snow)	May 3	0.0"
			Mar 29	8.0" (21" snow)		
Lost Soul (4,800')	Jan 10	7.6" (30" snow)	Mar 1	11.5" (36" snow)	May 3	2.4" (5" snow)
			Mar 29	12.1" (35" snow)	May 16	0.0"
Banfield Mtn. (5600')	Jan 10	10.2" (38" snow)	Mar 1	16.7" (49" snow)	May 3	14.4" (30" snow)
			Mar 29	19.0" (49" snow)	May 16	7.4" (15" snow)
					May 31	0.0"
Red Mt. (6,000')	Feb 27	13.2" (43" snow)	Mar 29	16.0" (47" snow)	May 1	14.1" 38" snow)
					May 15	9.9" (24" snow)
					Jun 5	0.0"
Stahl Peak (6050')	Feb 26	33.5" (89" snow)	Mar 26	37.2" (97" snow)	Apr 30	43.9" (90" snow)
					May 14	39.1" (77" snow)
					May 29	28.0" (53" snow)

b. *Snow pillow summary-Banfield Mountain, 1973-74

Water Year	Oct 1	Oct 15	Nov 1	Nov 15	Dec 1	Dec 15	Jan 1	Jan 15
1973	0.0	0.2	2.1	2.0	3.2	3.8	8.8	10.9
1974	0.0	0.0	0.1	3.3	8.5	10.7	13.4	16.5[e]
	Feb 1	Feb 15	Mar 1	Mar 15	Apr 1	Apr 15	May 1	May 15
1973	12.3	13.7	14.6	16.1	16.5	15.6	14.3	8.2
1974	21.6[e]	25.0[e]	28.6	20.6[e]	33.0	33.9	31.0	-
	Jun 1	Jun 15	Jul 1	Jul 15				
1973	0.0	-	-	-				
1974	-	-	-	-				

* Values in snow water content, inches

e, estimate

The increase in reservoir width indicates that the water level is higher on 11 and 29 September and 17 October 1973 (Fig. 6a, b and c, respectively) than observed on 3 April (Fig. 5b). Ground fog (1) was evident along sections of the river valley on the 17 October image (Fig. 6c), yet the water/land boundary was faintly visible through the haze. Isolated snow patches, observed in these fall scenes (Fig. 6a, b and c), were at elevations above 6,000 ft. The areal extent of snow above 6,000 ft had increased between September and October. The rate of snow ablation and accumulation can be monitored on the imagery. Less than one percent of the area within the Lake Koocanusa basin had visible snow cover for each of the above fall dates. Although a larger percentage of the ground is believed to have been snow-covered, it was obscured by vegetation and the regional snowline was not apparent until after 17 October. The primary factors influencing the regional snowline elevation are snowfall and air temperature. Exceptions are caused by localized effects of solar irradiation, vegetation density and foliage, snow depth variations due to drifting, wind scouring, variable snow accumulation and the positioning of air masses (particularly Canadian cold fronts) over land areas.

An approximation of water volume in the snow cover can be calculated based on the areal snow distribution obtained from the imagery and the average snow water content derived from the U.S. Department of Agriculture "Soil Conservation Service water supply data records for the Kootenai River basin" (Table 1).[2] Refer to Appendices I and II for surface measurements of snow on the ground.

The same spectral bands and techniques employed in analysis of ice cover were utilized in the analysis of turbidity and plankton concentrations. Band 5 was used to observe water turbidity, whereas band 7 was used to locate land/water boundaries. The only evidence of turbidity was observed on the 3 April band 5 image (Fig. 5a).

Conclusions

The accumulation and ablation of snow can be monitored utilizing satellite imagery. In addition it is possible to map the snowline and extent of turbidity on a regional and timely basis. Data on snow extent and depth, temperature, and water content compiled by standard ground truth procedures can be extrapolated with confidence to a regional area when LANDSAT-1 imagery is available as ancillary information.

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1. McKim, H.L., T.L. Marlar and D.M. Anderson (1972) The use of ERTS-1 imagery in the National Program for the Inspection of Dams. U.S. Army Cold Regions Research and Engineering Laboratory Special Report 183, 17 p.

2. U.S. Department of Agriculture (1972) Soil Conservation Service water supply data records for the Kootenai River Basin, Montana.

III. LIMNOLOGY OF LAKE KOOCANUSA, MONTANA

John E. Hobbie*

Introduction

The construction of Libby Dam on the Kootenai River, Montana, raised many questions about eventual limnological conditions in Lake Koocanusa. It is obvious that the lake has the possibility of becoming quite eutrophic (meaning biologically rich) as there is a relatively high rate of input of the nutrients (nitrogen and phosphorus) required for plant photosynthesis. A preliminary evaluation of the eutrophication potential of Lake Koocanusa prepared by the Environmental Resources Section, Seattle District, Corps of Engineers clearly stated the problem. The evaluation indicates that Lake Koocanusa lies within the danger area for eutrophication with respect to rates of input of both nitrogen and phosphorus.

There is, however, a great difference between potential eutrophication and actual results. Data from 1972 and 1973 show that the lake was not very productive at that time. Obviously the situation is a complicated one. The objective for this part of the investigation was to assess the present limnology of Lake Koocanusa and the potential for water quality problems with special reference to the potential for eutrophication.

Physical factors affecting photosynthesis

The eutrophication of lakes almost always starts with increases in phytoplankton photosynthesis. This leads to increased algal populations and eventually to changes in species and a proliferation of algae that interfere with man's use of the water (e.g. drinking water, recreation). The physical factors that control photosynthesis are temperature and light. In lakes, the amount of light reaching the algae is in part a function of the turbidity of the water.

At the surface of lakes there is almost always too much light for the algae. There is so much light, in fact, that the algal photosynthesis is inhibited at the surface and does not reach a maximum until light is reduced to 75 to 50% of the surface. This effect is seen in data from the Forebay Station of Lake Koocanusa on 18 June 1973 (Fig. 7). The lower limit of photosynthesis is around the level of 1% of surface light and on 18 June this was at 6.8 m in Lake Koocanusa.

The primary productivity measurements, such as those in Figure 7, are determined by suspending water samples in bottles at a series of depths for a portion of the day. In reality, however, the algae are moving through the water column as the water circulates. If the algae spend most of their time below the depth of the 1% light level, then they cannot accumulate enough energy for reproduction. Thus, the depth of circulation of the water becomes very important to algal growth.

In Lake Koocanusa the depth of circulation of the top waters in 1973 was 0 to 30 ft in the spring and then fell to 180 ft by late June. This depth is given as the epilimnion bottom in Figure 8. The situation in Koocanusa may be compared with temperature data from Brownlee Reservoir on the Snake River (Fig. 9) which showed an orderly progression of temperature gradient changes. This progression might be expected at Lake Koocanusa as well. Instead, in Lake Koocanusa normal stratification began to develop in April and May (Fig. 10), but between the 14th and 21st of May the lake began to fill rapidly. The result of this large

* *CRREL Expert, Marine Biology Laboratory, Woods Hole, Massachusetts.*

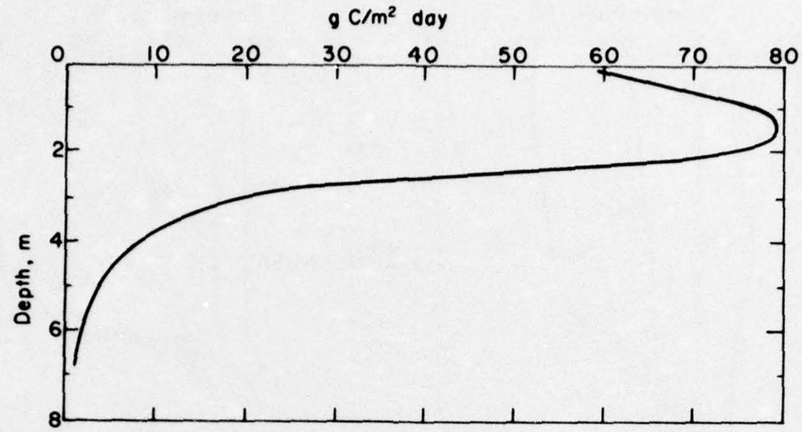


Figure 7. Primary production on 18 June 1973, Forebay Station, Lake Koocanusa.

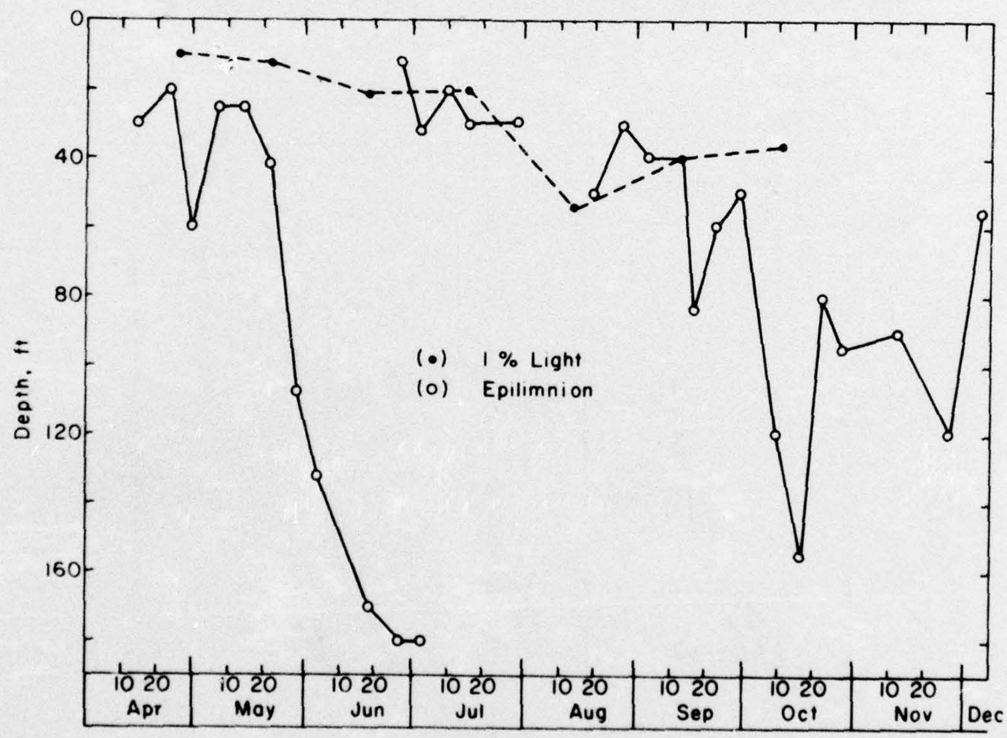


Figure 8. Depth of 1% surface light and the epilimnion bottom of Lake Koocanusa, 1973.

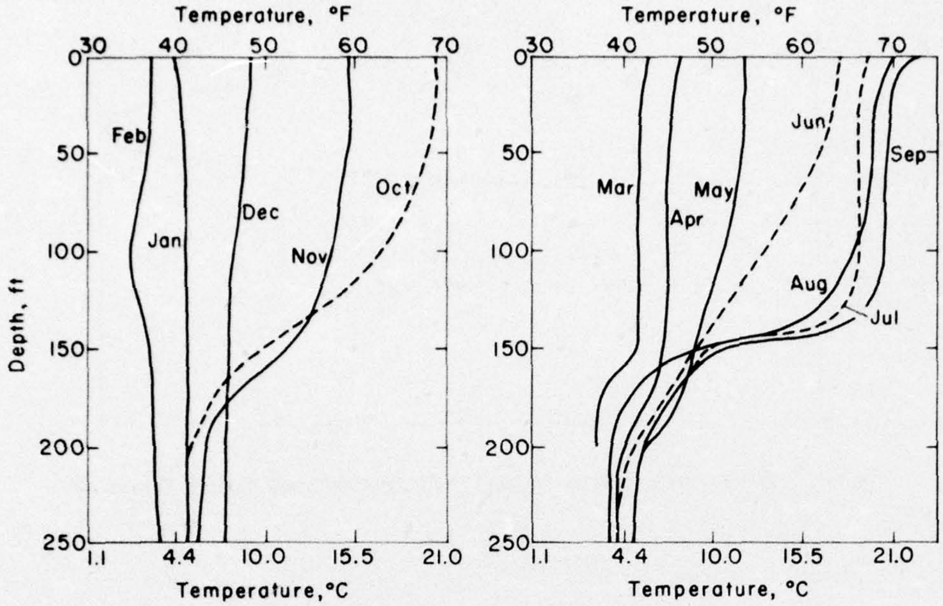


Figure 9. Monthly temperature gradients of Brownlee Reservoir, Snake River.

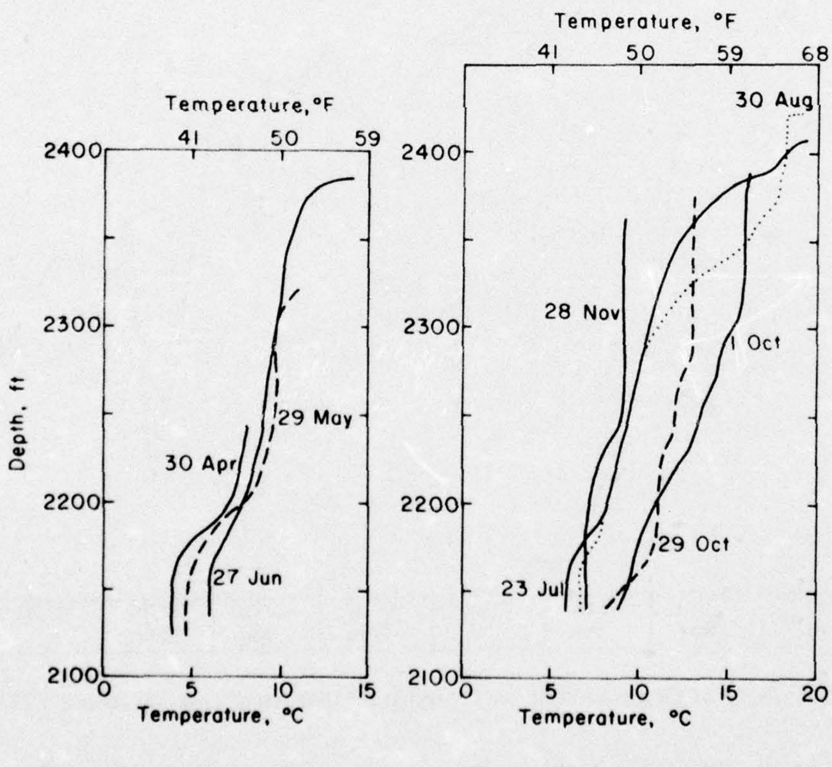


Figure 10. Monthly temperature gradients, Forebay Station, Lake Koocanusa.

inflow of water was to deepen the epilimnion while the thermocline remained at a constant level, 2200 ft above sea level.

The temperature profiles for July and August (Fig. 10) which show secondary thermal stratification near the surface are typical of unstable situations that last only a day or a week before the entire epilimnion is circulated by wind. The lake began to cool in October and by 28 November it was below 10°C.

The result of such a stratification cycle was shallow circulation in April and May, deep circulation in June, a shallow circulation in July and August (but with a chance that it may have broken down several times), and deeper circulation again in September, October, and November.

The lake was relatively turbid (Fig. 8) and the depth of the 1% light level varies between 10 and 55 ft in 1973. Only in April and May and perhaps in July and August were the conditions at all favorable for algal photosynthesis: only during these periods did the algae obtain enough light for photosynthesis and growth.

The 1973 primary productivity values for the Forebay Station were: 27 April-230, 22 May-170, 18 June-220, 16 July-100, 14 August-120, 1 September-120, and 1 October-70 g C/m^2day. There was a buildup of algae and of production in April, May and early June but a decline to around 100 g C/m^2 day in the following months. Thus, it appears that conditions for photosynthesis were not good during July and August, despite the apparent shallow stratification.

Chemical factors affecting photosynthesis

Both the phosphorus and nitrate concentrations were appreciably lower in the surface waters than in the deep waters of Lake Koocanusa. However, there was only one period, between 9 July and 28 August, when the phosphorus concentration in the surface waters fell below 0.02 mg/liter. Unfortunately, the technique used was not sensitive to concentrations below 0.01 mg P/liter, but algae are quite capable of taking up phosphorus when the concentration is 0.005 mg/liter.

The nitrate nitrogen was low (below 0.03 mg N/liter) for a brief period in late April and early May, and then was low again for a long period that covered most of August, September and October. There are no measurements of ammonia, which can also be used by algae as a source of nitrogen. Therefore, although there may have been some reduction of photosynthesis by the low level of nitrate, this importance cannot be determined without measurements of ammonia.

Primary production

A rough calculation of the total annual production comes to 33 g C/m^2 year. This means that, in terms of primary production, Lake Koocanusa is an oligotrophic lake comparable to lakes in Alaska and Norway and to Lake Tahoe. Primary production in eutrophic lakes is characteristicly 100 to 150 g C/m^2 yr and lakes with severe algal blooms may be in the 300- to 800-g C/m^2 yr range.

Thus, the lake did not fulfill its potential for eutrophication. The reasons for this are not completely clear, but the great depth of the circulation zone and the relatively shallow depth of the zone with sufficient light for photosynthesis were certainly very important. It is likely, for example, that deep circulation in mid- to late-June completely destroyed the populations of algae that were built up during April, May and early June.

Conclusions

Lake Koocanusa has the potential for algal blooms from the moderately high quantities of nutrients that enter the lake. The previous schedule of extreme water drawdown during the winter and filling with water during the spring runoff prevented a stable stratification from developing. This resulted in the algae being circulated for a large percentage of the time below the depth of the 1% light level that allows large populations of algae to develop. Another factor which contributed to the low productivity was the relatively high turbidity of the lake.

Recommendations

The following list of recommendations is based on data available June 1974. Changes in the sampling program may have already been made which will obviate some of these recommendations.

1. The danger of eutrophication was still present in the lake and monitoring should be continued.

2. Primary production should be measured at two-week intervals at several stations in the lake.

3. Nutrient measurements should include ammonia and should be taken at a number of depths (at least three) in the upper waters and at two depths in deep water.

4. Chemical measurements should include all cations, anions and trace metals, but would not need to be carried out for more than three times a year.

5. Biological measurements of algal species and biomass should be carried out at the same stations and depths as the primary production measurements are made. At least three depths should be sampled. At the same time chlorophyll measurements should be made at the three depths (where algal measurements are made) plus several at greater depths in order to see if algal populations are present at depth. Previous algae measurements were probably missing a large part of the total algal population (the very small nannoplankton forms).

IV. LANDSAT-1 DATA COLLECTION SYSTEM

Harlan L. McKim* and Bruce E. Brockett* 4

Introduction

The LANDSAT-1 Data Collection System (DCS) provides the capability to collect, transmit and disseminate data from hydrologic, meteorologic and environmental sensors located at remote sites throughout the United States. The primary objective of the effort described in this section was to establish the reliability of the DCP-Martek system under actual remote conditions. Through cooperation with the Seattle District, Corps of Engineers, Libby Dam in Libby, Montana, was chosen as the remote test site where daily baseline data on water quality and climatic parameters could be acquired. The specific objectives were:

1) to demonstrate that a LANDSAT-1 DCP could be used in a continuous operation mode for the acquisition of water quality data at the Libby Dam-Lake Koocanusa project

2) to study the use of additional climatic sensors for measuring air temperatures and precipitation.

The total data collection system includes the sensors, data collection platforms (DCP), satellite relay equipment and ground receiving stations (Fig. 11a). The transmission of data through the LANDSAT-1 system is accomplished by millivolt analog input from the sensors via the DCP to LANDSAT-1. The satelitte transmits the signal to ground stations located at either Goddard Space Flight Center, Maryland, or Goldstone, California. Messages received by Goldstone are compiled and transmitted to Goddard every two hours. Goddard teletypes messages directly to the New England Division, Corps of Engineers, Waltham, Massachusetts, which in turn teletypes the messages to CRREL (Fig. 11b). At CRREL the messages are converted to sensor data and can be teletyped to appropriate stations, for example, to Libby Dam and the Seattle District as done during this study (Fig. 11b). Other pertinent information about the data collection system is available in the NASA "ERTS data users handbook."[7]

During the past two years personnel at CRREL have interfaced water quality, meteorologic and hydrologic sensors to DCP's and tested these combinations. Of the water quality instruments evaluated, the Martek Water Quality Monitor was considered the most suitable for field test because it operates on either line or battery power, is compact and can measure five variables: water temperature, conductivity, pH, dissolved oxygen and sensor depth.

The range scales selected for the depth probe, the four water quality sensors and the meteorological sensors are given in Table 2. Since the accuracy of the DCP-Martek system is one percent of full scale, greater accuracy could have been achieved by reducing the scales, thus narrowing the monitoring ranges. However, maximum ranges were chosen to obtain the optimum number of data points.

Initial testing of DCP

Preliminary testing and evaluation to substantiate the performance of the DCP-Martek system under simulated remote conditions was accomplished at Wilder Dam, Vermont (Fig. 12) on the Connecticut River, three miles south of Hanover, New Hampshire. The proximity of the dam to CRREL enabled easy access for installation and monitoring. A field calibration laboratory (Fig. 13), the data collection platform and Martek

** Chief, Earth Sciences Branch, and Physical Science Technician, respectively, U.S. Army Cold Regions Research and Engineering Laboratory.*

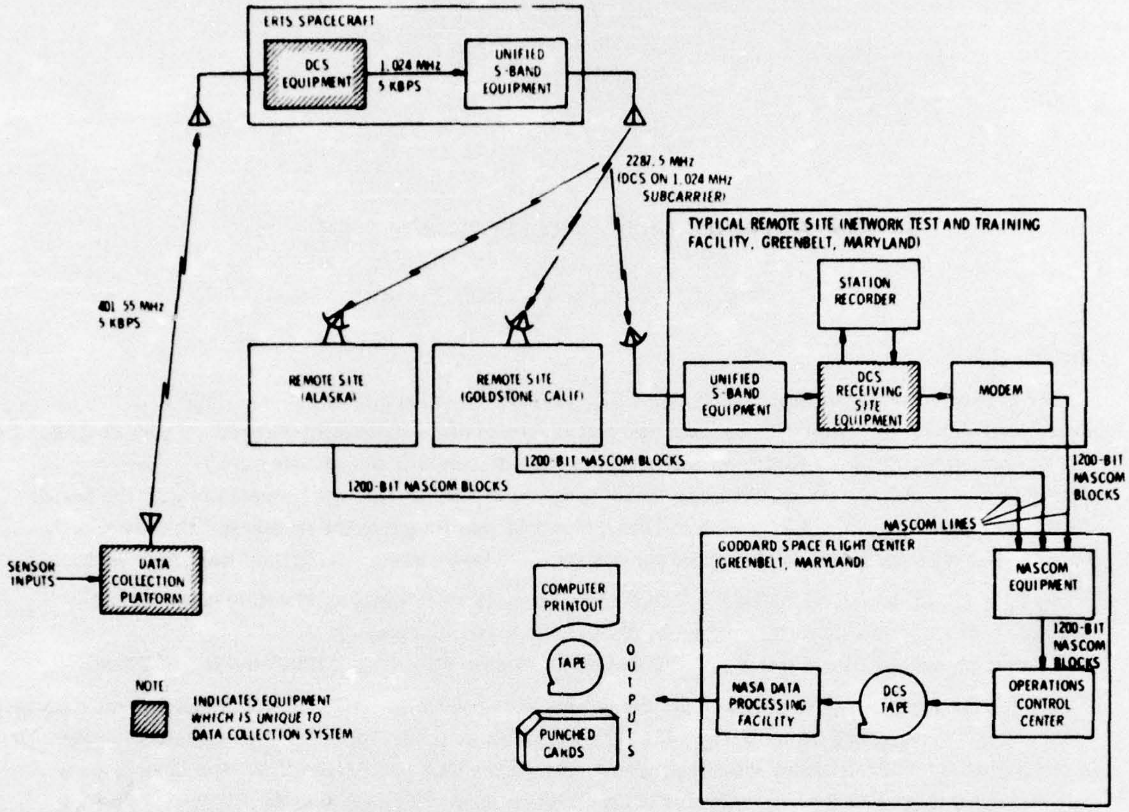


Figure 11a. LANDSAT-1 data collection system.

Table 2. Range scales for the sensors.

	Water Depth (ft)	Water Temperature (°C)	Conductivity (mmhos/cm)	pH	Dissolved Oxygen (ppm)	Air Temperature (°C)	Precipitation (in.)
Max	30.0	50.0	1.4	12.0	20.0	-20	2.56
Min	0.0	-10.0	0.0	0.0	0.0	+30	0.0

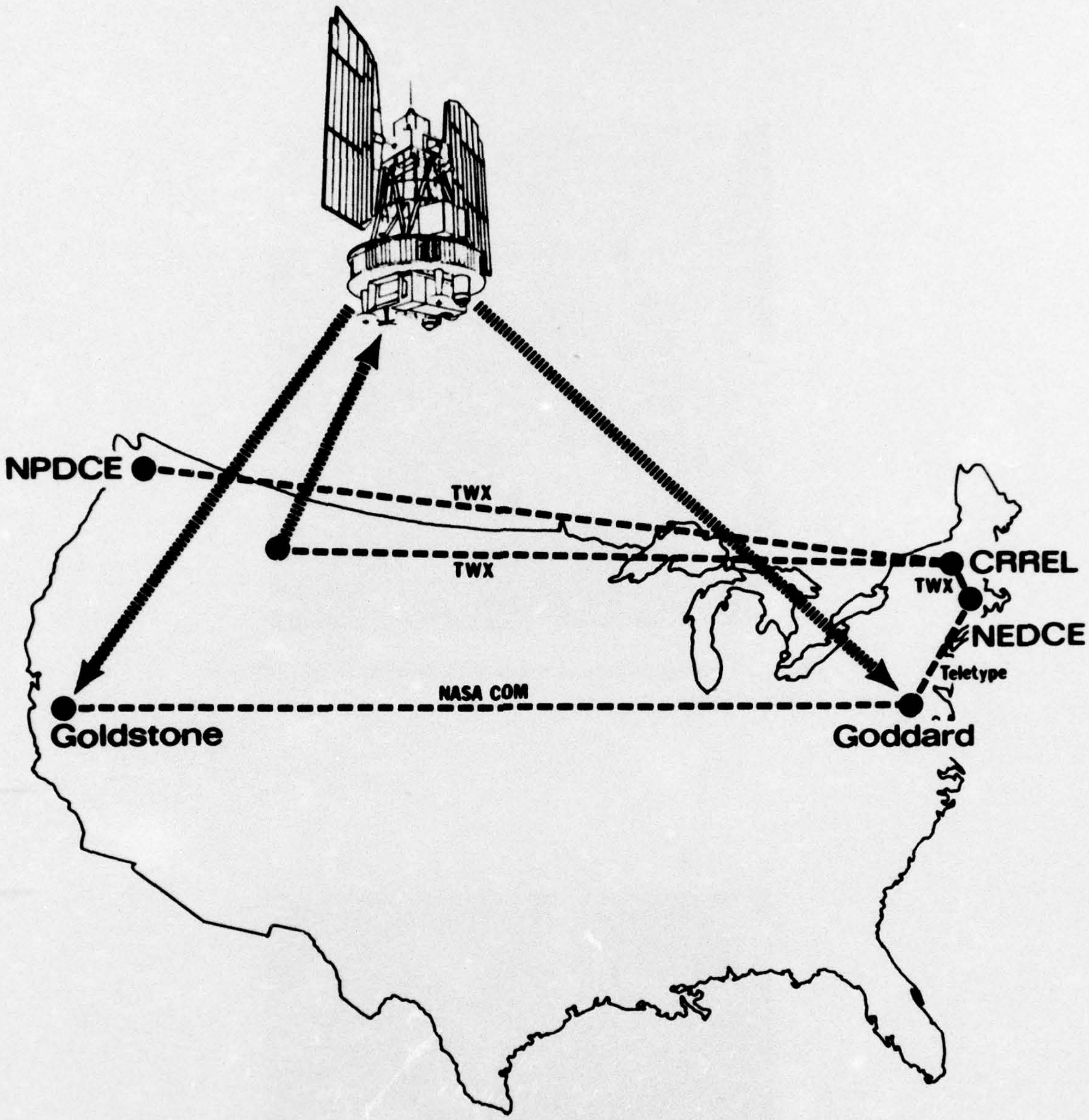


Figure 11b. LANDSAT-1 data dissemination to users.

monitor were placed in the gauge house on the upper level of the dam. The sensor probes (Fig. 14) were suspended in a fixed position 6 ft from the face of the dam and 2 ft below the minimum river stage (Fig. 15). Water samples were obtained at selected intervals and analyzed on site. The values obtained from the data collection system compared favorably to the calibration data. Except for a malfunction of the water temperature sensor, the equipment operated adequately during the two-month testing period and was removed on 19 December 1973.

During this test interval an average of 10 messages every 12 hours were received at the laboratory (Table 3). These hourly data points were reduced to daily values for each of the water quality sensors as shown in Figure 16. The experience gained from the Wilder Dam test indicated that the LANDSAT-1 Data Collection System supplied near real time water quality values under simulated remote conditions.

Figure 12. Gauge house and impoundment area, Wilder Dam Wilder, Vermont.

Figure 13. Field calibration laboratory.

Table 3. Water quality data, Wilder Dam Vermont.

21 October 1973

RSID	TIME	DEPTH (ft)	WTEMP (°C)	COND (mmhos/cm)	pH	D.O. (ppm)
N	955	0.5	7.5	0.01	6.7	9.3
N	958	0.5	7.3	0.01	6.7	9.3
N	1001	0.5	7.3	0.01	6.7	9.3
N	1004	0.5	7.5	0.01	6.7	9.3
N	1136	0.4	7.5	0.01	6.7	9.3
G	1139	0.4	7.5	0.01	6.7	9.3
N	1139	0.4	7.5	0.01	6.7	9.3
G	1143	0.4	7.1	0.01	6.7	9.3
N	1143	0.4	7.1	0.01	6.7	9.3
N	1952	0.2	8.5	0.01	6.7	9.2
N	1959	0.2	8.0	0.01	6.7	9.2
N	2130	0.2	8.2	0.01	6.7	9.2
N	2134	0.2	8.0	0.01	6.7	9.2
N	2137	0.4	8.0	0.01	6.7	9.2
N	2140	0.4	8.0	0.01	6.7	9.2

RSID is Receiving Station I.D.:

N - Goddard Space Flight Center Receiver

G - Goldstone Space Flight Center Receiver

Installation and operation of DCP and sensors

The DCP-Martek calibration and sensor packages were initially installed and operated in a completely portable mode on a floating platform in Lake Koocanusa (Fig. 17). The site was located near the center of the protecting log boom above the dam. It was necessary to operate entirely on battery power during this test period. In order to evaluate accuracy of the system, personnel from the U.S. Geological Survey conducted tests of water quality using an identical Martek water quality analyzer simultaneously with the DCP/Martek installation. Their results compared favorably to the CRREL data received via the satellite relay system for three of the five sensors. The conductivity and pH probes suffered minor damage during shipment and did not operate properly but did transmit a signal. Preliminary testing was terminated after four days when ground truth had been established, accurate data received and the versatility and portability of the entire DCP system demonstrated.

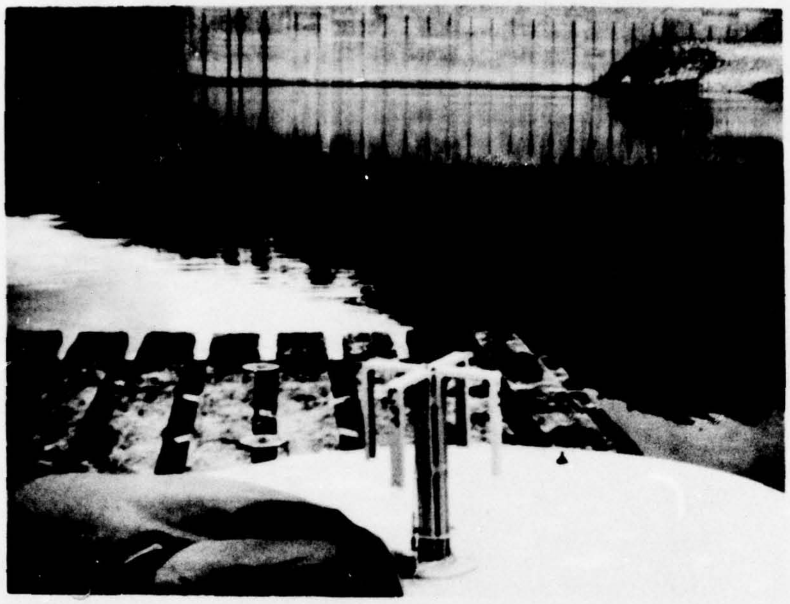
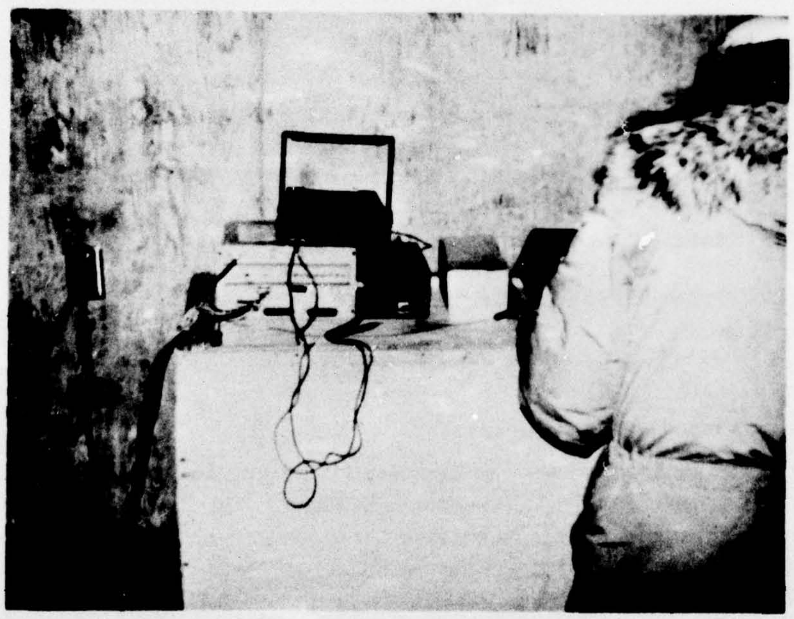
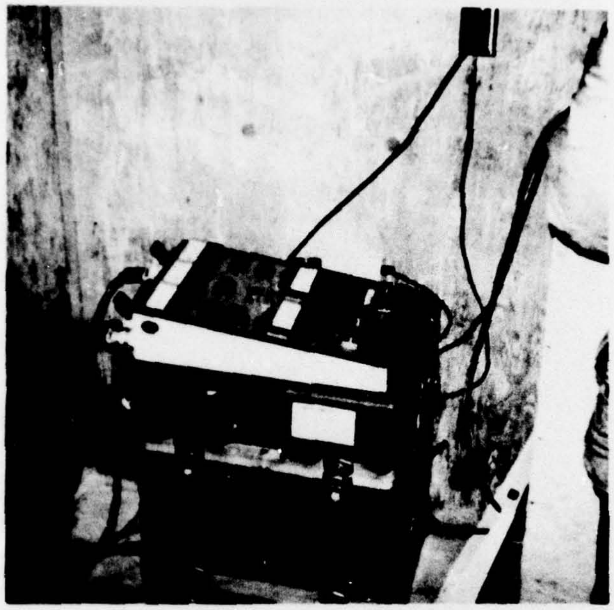


Figure 17. Floating DCP antenna and platform on Lake Koocanusa, Montana.

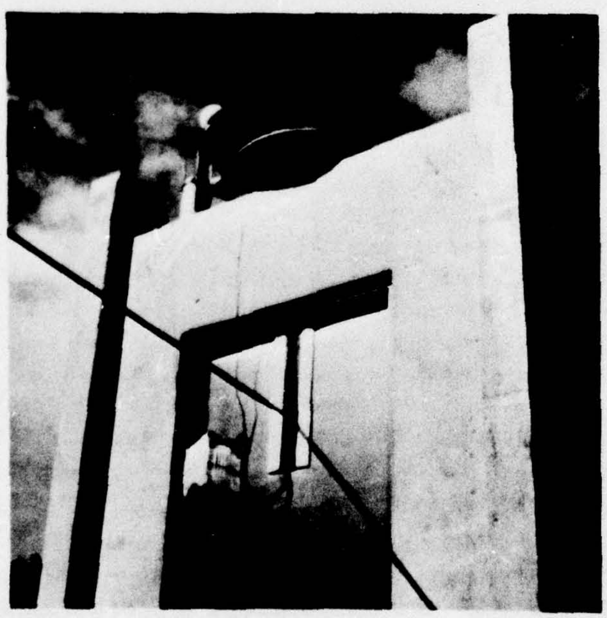


a. DCP and power supply.

Figure 18. DCP-Martek calibration package located at Libby Dam water quality and gauging station.



b. Martek instrument package.



c. Location of air temperature, precipitation and DCP antenna.

Figure 18 (cont'd).

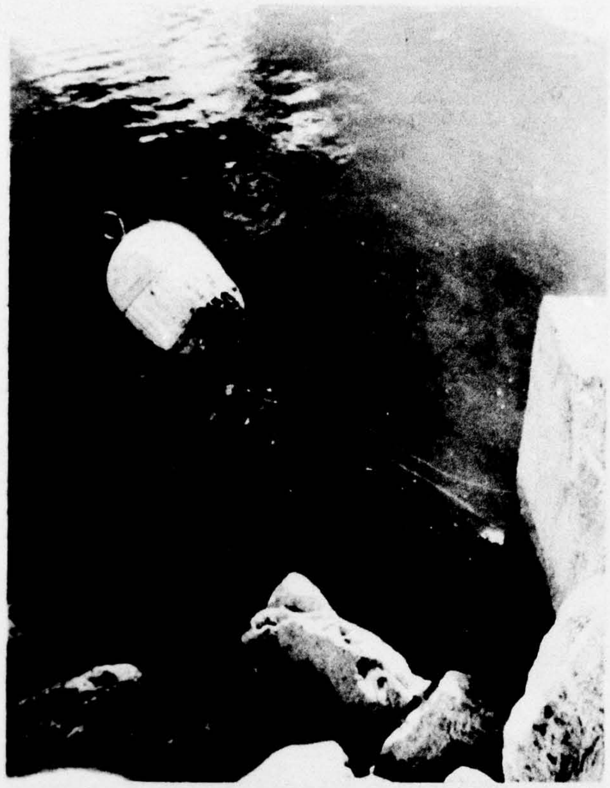


Figure 19. Downstream site location of water quality probes.

On 19 February the data collection system was transferred to a site located approximately 0.25 mile downstream of the dam in the immediate vicinity of the Libby Dam water quality monitoring station. The DCP-Martek calibration package was positioned in the water quality laboratory of the monitoring station (Fig. 18a, b and c). The sensor package was suspended from a floating buoy in back water near shore (cable lengths restricted the allowable distance from the house) (Fig. 19). The relocation of the entire data collection system was completed within five hours without loss of data transmitted via the satellite. The USGS conducted analysis on water in the immediate vicinity of the Martek water quality sensors, and again, comparable results were obtained. After installation of the data collection system and establishment of data handling procedure, the task of demonstrating long-term remote operation was initiated. Slight inconsistencies in the water quality signals and a malfunction of the pH probe were noted during the testing period, although most values received were within the range of accuracy of the total system (Table 4). The daily averages of the parameters measured are shown in Figure 20.

On 5 April 1974 a field trip was made to investigate the signal inconsistencies and probe malfunction and to install a rain gauge and air temperature sensor. The sensor package was removed from the Kootenai River on 5 April and was found to be partially coated with a thick growth of algae (Fig. 21). It was believed that the inconsistencies in the signal were due not only to this algae buildup but also to continuous river stage fluctuations. The sensors were thoroughly cleaned, replaced in the river and recalibrated, but the pH sensor could not be repaired at this time.

From 5 April to 25 May the air temperature and rain gauge functioned properly (Table 5). However, the three-minute messages from the water quality monitor continued to show minor inconsistencies. To isolate the cause, a constant voltage source was assembled at CRREL and installed at Libby Dam on 25 May. A

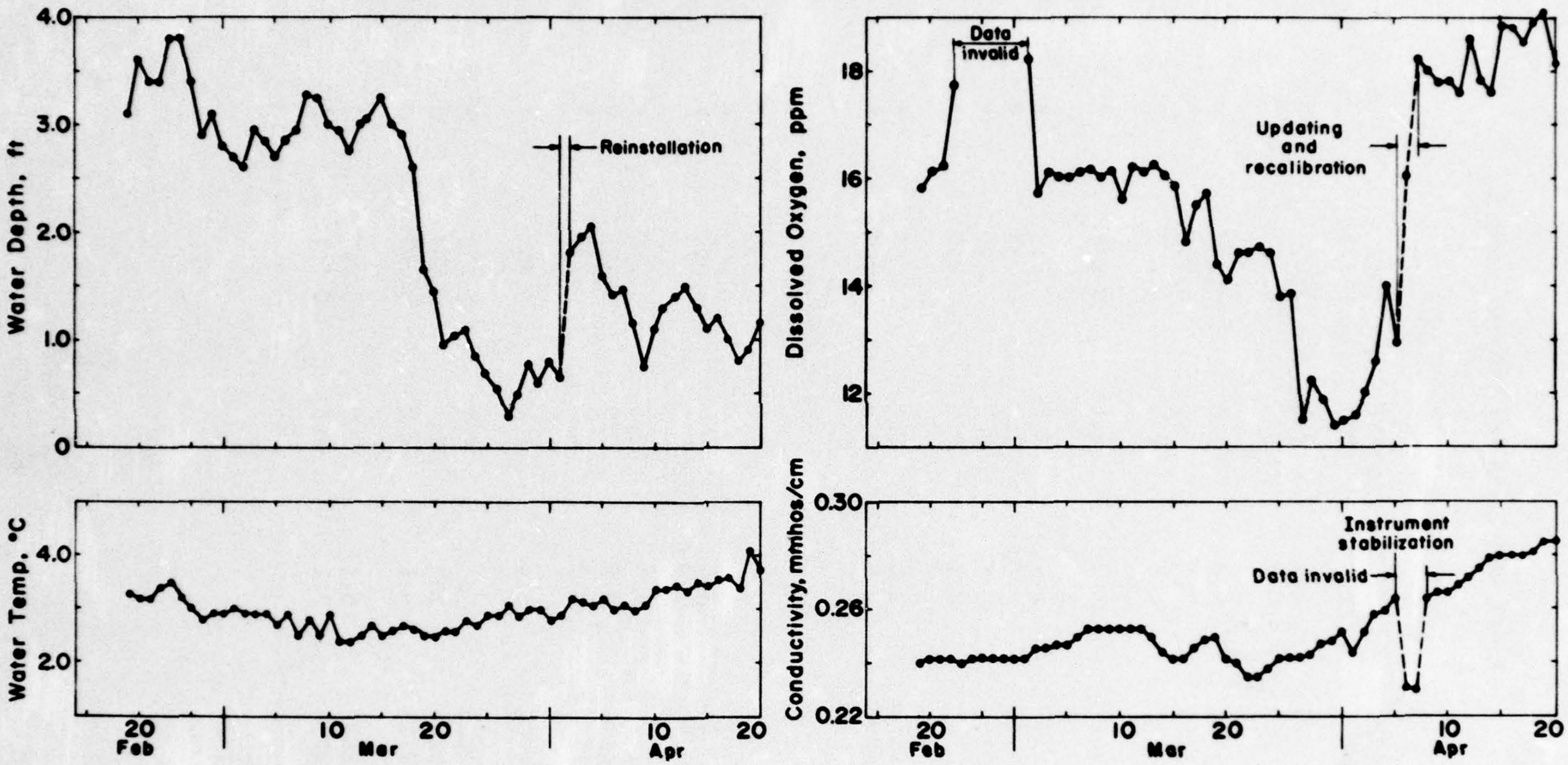


Figure 20. Water quality data, February through April, 1974, Libby Dam, Montana.

Table 4. Water quality data, Libby Dam, Montana.

12 March 1974

RSID	TIME	DEPTH (ft)	WTEMP (°C)	COND (mmhos/cm)	pH	D.O. (ppm)
G	925	2.9	2.5	0.253	*	16.2
G	929	2.9	3.2	0.253	*	16.2
G	1108	2.8	2.0	0.253	*	16.4
G	1112	2.8	2.5	0.253	*	16.4
G	1115	2.8	2.5	0.253	*	16.3
G	1927	2.7	2.5	0.253	*	16.8
G	2102	2.7	2.2	0.253	*	15.8
G	2102	2.7	2.7	0.253	*	15.8
G	2105	2.7	2.2	0.253	*	16.0
G	2109	2.7	2.5	0.253	*	16.1
G	2244	2.8	2.7	0.253	*	16.0
G	2247	2.8	2.2	0.253	*	16.1

13 March 1974

RSID	TIME	DEPTH (ft)	WTEMP (°C)	COND (mmhos/cm)	pH	D.O. (ppm)
G	928	2.9	2.0	0.253	*	16.1
G	931	2.9	2.9	0.253	*	16.0
G	934	2.9	2.5	0.253	*	16.2
G	1111	2.9	2.5	0.253	*	16.6
G	1114	2.9	2.9	0.253	*	16.5
G	1118	2.9	2.2	0.253	*	16.6
G	1932	2.9	2.7	0.247	*	16.2
G	2108	3.1	2.7	0.247	*	16.2
G	2112	3.1	2.5	0.247	*	16.2
G	2115	3.1	2.5	0.247	*	16.2
G	2251	3.1	2.2	0.247	*	16.2
G	2254	3.1	2.5	0.247	*	16.0

*inoperative

Table 5. Water quality, air temperature and precipitation data, Libby Dam, Montana.

26 April 1974

RSID	TIME	DEPTH (ft)	WTEMP (°C)	COND (mmhos/cm)	pH	D.O. (ppm)	ATEMP (°C)	PREC (in)
G	1015	0.7	4.6	0.296	*	19.9	7.5	0.10
G	1018	0.7	4.4	0.296	*	19.3	7.5	0.10
G	1021	0.7	4.1	0.296	*	18.6	7.5	0.10
G	1157	0.8	3.9	0.296	*	18.9	7.8	0.10
G	1200	0.7	4.8	0.296	*	19.2	7.8	0.10
G	2012	0.7	4.6	0.296	*	18.9	9.2	0.10
G	2015	0.7	5.1	0.296	*	19.5	8.2	0.10
G	2151	0.7	4.6	0.296	*	19.1	6.9	0.10
G	2154	0.7	4.6	0.296	*	19.4	7.3	0.10
G	2157	0.7	5.1	0.296	*	19.4	7.3	0.10

27 April 1974

RSID	TIME	DEPTH (ft)	WTEMP (°C)	COND (mmhos/cm)	pH	D.O. (ppm)	ATEMP (°C)	PREC (in)
G	1019	0.8	4.1	0.291	*	19.6	4.7	0.37
G	1022	0.8	5.1	0.296	*	19.1	5.1	0.37
G	1025	0.8	5.5	0.291	*	19.1	5.3	0.38
G	1028	0.8	4.1	0.296	*	19.4	5.9	0.38
G	2157	1.1	4.6	0.296	*	19.2	5.5	0.44
G	2200	0.9	4.6	0.296	*	19.1	5.5	0.44
G	2204	0.9	4.6	0.296	*	18.6	5.5	0.44

28 April 1974

RSID	TIME	DEPTH (ft)	WTEMP (°C)	COND (mmhos/cm)	pH	D.O. (ppm)	ATEMP (°C)	PREC (in)
G	1026	1.1	4.8	0.291	*	19.1	11.4	0.44
G	1029	1.3	4.8	0.291	*	19.2	11.0	0.44
G	1032	1.3	4.6	0.291	*	19.1	11.0	0.44
G	1207	1.2	4.6	0.291	*	19.1	11.2	0.44
G	1210	1.2	4.6	0.291	*	19.4	11.2	0.44
G	1213	1.2	4.6	0.291	*	19.5	10.6	0.44
G	2023	0.9	4.8	0.285	*	18.7	11.0	0.44
G	2203	1.1	5.1	0.285	*	18.7	9.2	0.44
G	2206	1.1	4.8	0.285	*	19.1	8.8	0.44
G	2209	1.1	4.8	0.285	*	19.1	8.8	0.44

* inoperative

Figure 21. Algae buildup on water quality probe after one month.

constant 2.53 volt signal was applied to all 8 channels and transmitted through the data collection system to CRREL without variation. This established that the inconsistencies were not associated with the data collection system but were within the sensor package and caused by environmental conditions at the test site. The study was completed on 12 June and the data collection system was returned to CRREL.

Conclusions and recommendations

The portability of the DCP and the reliability of the data transmitted in nearly real time have been demonstrated. The variability in measurements that occurred during this investigation is associated with the state of the art of the sensors, which were not designed for long-term, unattended operation. Acquisition of data on a nearly real time basis, while maintaining ground truth, was achieved at the Wilder Dam and Lake Koocanusa sites. While problems encountered in the Kootenai River caused reduced reliability of the data, the problems were discovered within hours and corrective action initiated.

The following variables have been successfully measured with sensors interfaced to the DCP by CRREL over the last three years:

Depth
pH
Dissolved oxygen
Conductivity
Air temperature
Water temperature
Precipitation
River stage
Wind direction and velocity.

Additional environmental and hydrologic sensor packages to measure:

Turbidity
Ice thickness

Water equivalency of snow*
Soil moisture
Relative humidity
Solar radiation

should be tested for possible use in the Corps of Engineers program.

References

1. NASA (1972) LANDSAT-1 data users handbook. Goodard Space Flight Center, Document No. 715D4249.

** Upon completion of this project a DCP interfaced with a snow pillow was installed at the proposed site for the Devils Canyon Dam on the Susitna River in Alaska. The instrumentation operated successfully for most of the 1974-1975 winter.*

APPENDICES I, II AND III

APPENDIX I

Monthly Climatic Summaries for Stations in the
Lake Koocanusa Drainage Basin, Montana and British Columbia

1972 - 73

Aberfeldie, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	39.1	33.1	17.3	18.6	28.1	39.2	44.0
Ave. Minimum Temp (°F)	28.9	26.3	10.9	9.7	17.9	29.5	31.7
Absolute Min. Temp (°F)	19	12	-19	-22	-6	23	22
No. of days with Freezing Temp.	24	27	23	29	26	22	14
Precipitation (water equivalent) (in)	1.32	0.69	3.06	1.78	1.07	0.53	0.95
Snowfall Amount (in)	6.3	2.9	6.5	6.5	3.9	0.0	0.9
Snow on the Ground (in)	0	--	--	--	--	--	--

Canal Flats, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	39.5	31.5	11.9	17.9	25.4	38.4	43.6
Ave. Minimum Temp (°F)	29.7	25.0	6.0	10.1	14.9	28.1	31.1
Absolute Min. Temp (°F)	16	9	-21	-24	-12	21	20
No. of days with Freezing Temp.	23	26	26	28	25	26	19
Precipitation (water equivalent) (in)	1.10	0.40	2.32	0.92	0.62	1.42	0.26
Snowfall Amount (in)	4.5	0.6	12.1	4.4	6.2	11.5	T
Snow on the Ground (in)	0	--	--	--	--	--	--

Cranbrook, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	38.6	30.5	14.5	16.3	24.8	37.2	42.7
Ave. Minimum Temp (°F)	28.4	24.1	6.9	7.0	13.9	27.6	30.9
Absolute Min. Temp (°F)	12	10	-25	-25	-13	18	18
No. of days with Freezing Temp.	24	30	27	29	27	28	20
Precipitation (water equivalent) (in)	0.82	0.38	1.36	1.18	0.81	0.9	0.21
Snowfall Amount (in)	7.1	2.5	7.7	9.2	12.4	4.8	2.2
Snow on the Ground (in)	2	T	3	2	2	0	0

Elkford, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	35.2	27.7	11.5	13.1	19.9	30.9	36.5
Ave. Minimum Temp (°F)	24.6	20.1	3.6	3.5	7.7	20.0	25.2
Absolute Min. Temp (°F)	5	2	-31	-28	-19	3	10
No. of days with Freezing Temp.	29	30	30	31	28	31	27
Precipitation (water equivalent) (in)	1.53	0.30	3.54	2.28	1.04	1.28	1.11
Snowfall Amount (in)	6.9	2.4	26.2	21.8	10.4	6.8	3.0
Snow on the Ground (in)	0	--	--	--	--	--	--

Elko, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	39.0	33.0	17.4	18.5	27.3	37.6	42.8
Ave. Minimum Temp (°F)	29.0	26.8	11.5	10.3	18.0	27.9	31.0
Absolute Min. Temp (°F)	20	10	-19	-19	-3	20.	20
No. of days with Freezing Temp.	23	27	22	29	26	27	19
Precipitation (water equivalent) (in)	1.05	0.78	2.56	1.24	0.93	0.59	0.75
Snowfall Amount (in)	0.2	2.8	7.1	7.8	6.7	1.3	0.3
Snow on the Ground (in)	0	--	--	2	--	--	--

Eureka, MT (Ranger Sta)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	39.9	33.6	17.4	20.5	27.5	40.4	45.1
Ave. Minimum Temp (°F)	28.5	26.9	9.2	11.5	17.7	29.4	31.1
Absolute Min. Temp (°F)	14	7	-30	-26	-14	19	16
No. of days with Freezing Temp.	24	25	20	28	26	21	19
Precipitation (water equivalent) (in)	2.44	0.37	1.32	0.87	0.72	0.06	0.13
Snowfall Amount (in)	--	--	--	--	--	--	--
Snow on the Ground (in)	--	--	--	--	--	--	--

Fernie, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	38.2	32.4	15.7	17.8	24.0	35.5	40.2
Ave. Minimum Temp (°F)	26.9	25.8	7.8	8.7	13.5	26.2	28.3
Absolute Min. Temp (°F)	9	4	-31	-25	-17	17	14
No. of days with Freezing Temp.	25	26	28	30	27	28	23
Precipitation (water equivalent) (in)	2.66	1.74	7.88	4.53	3.11	2.37	1.66
Snowfall Amount (in)	12.8	6.4	21.1	25.2	22.9	11.6	2.6
Snow on the Ground (in)	--	--	--	4	6	--	--

Fording River Cominco, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	32.6	24.5	9.3	12.9	19.9	26.4	32.0
Ave. Minimum Temp (°F)	20.9	16.2	0.3	2.8	7.6	16.2	22.5
Absolute Min. Temp (°F)	-3	-4	-33	-30	-20	4	2
No. of days with Freezing Temp.	28	30	31	31	28	31	29
Precipitation (water equivalent) (in)	1.94	0.52	3.69	2.18	1.12	1.97	0.85
Snowfall Amount (in)	19.4	5.2	36.9	21.8	11.2	19.7	7.7
Snow on the Ground (in)	--	--	--	--	--	--	--

Fortine, MT

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	40.2	32.2	17.0	18.8	27.7	38.2	42.9
Ave. Minimum Temp (°F)	27.9	24.4	8.3	9.5	16.8	26.6	29.1
Absolute Min. Temp (°F)	15	2	-31	-27	-12	16	13
No. of days with Freezing Temp.	23	27	23	28	26	27	19
Precipitation (water equivalent) (in)	1.84	0.60	2.08	0.81	0.59	0.41	0.28
Snowfall Amount (in)	10.0	5.0	8.5	4.5	5.5	1.0	T
Snow on the Ground (in)	3	3	6	5	5	0	0

Ft. Steele Steeples Ranch, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	37.7	31.6	14.9	18.8	25.7	37.3	41.7
Ave. Minimum Temp (°F)	26.4	24.4	6.2	10.4	15.4	26.9	28.5
Absolute Min. Temp (°F)	15	5	-31	-29	-15	15	15
No. of days with Freezing Temp.	26	26	26	29	26	26	22
Precipitation (water equivalent) (in)	1.29	0.56	1.97	1.49	0.71	0.34	0.94
Snowfall Amount (in)	4.8	2.6	6.5	6.3	6.2	T	0.5
Snow on the Ground (in)	--	--	3	--	--	--	0

Grasmere, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	--	34.4	18.5	20.8	27.5	39.3	47.4
Ave. Minimum Temp (°F)	--	27.3	11.7	14.1	17.5	29.2	33.1
Absolute Min. Temp (°F)	--	13	-23	-24	-10	23	22
No. of days with Freezing Temp.	--	23	23	30	27	26	15
Precipitation (water equivalent) (in)	--	0.20	3.38	1.03	0.82	0.42	0.47
Snowfall Amount (in)	--	2.0	3.5	1.0	7.0	4.0	0.0
Snow on the Ground (in)	--	--	1	0	0	0	0

Kimberley, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	37.9	29.2	14.2	15.8	23.0	34.1	40.8
Ave. Minimum Temp (°F)	29.3	23.4	8.1	8.0	14.5	25.7	30.6
Absolute Min. Temp (°F)	13	10	-24	-20	-5	18	15
No. of days with Freezing Temp.	21	29	31	31	27	29	19
Precipitation (water equivalent) (in)	2.01	0.76	4.98	3.31	1.64	1.78	0.95
Snowfall Amount (in)	10.0	6.0	34.7	30.6	16.4	9.9	5.2
Snow on the Ground (in)	--	3	19	24	22	8	--

Kootenay N.P. (West Gate) BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	38.1	29.5	12.1	15.8	25.0	37.5	43.0
Ave. Minimum Temp (°F)	29.2	24.6	6.4	9.1	16.4	27.9	31.8
Absolute Min. Temp (°F)	17	12	-28	-23	-8	20	21
No. of days with Freezing Temp.	24	27	27	30	27	29	20
Precipitation (water equivalent) (in)	0.85	0.37	1.54	0.73	0.51	1.42	0.61
Snowfall Amount (in)	0.8	1.5	12.2	4.0	5.1	6.0	0.6
Snow on the Ground (in)	--	--	7	7	7	--	0

Libby Dam, MT

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	43.1	34.5	19.1	18.0	26.3	37.6	42.0
Ave. Minimum Temp (°F)	29.9	26.1	10.3	7.0	13.2	23.6	25.8
Absolute Min. Temp (°F)	21	9	-17	-20	-8	19	15
No. of days with Freezing Temp.	23	26	31	31	28	31	26
Precipitation (water equivalent) (in)	1.59	0.49	2.30	1.11	0.35	0.49	0.39
Snowfall Amount (in)	--	--	--	--	--	--	--
Snow on the Ground (in)	--	--	--	--	--	--	--

Marysville, BC (near Wycliffe)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	38.8	30.7	14.5	15.7	25.9	37.6	43.2
Ave. Minimum Temp (°F)	27.0	23.4	7.4	5.5	13.6	26.3	29.1
Absolute Min. Temp (°F)	9	8	-22	-24	-11	18	16
No. of days with Freezing Temp.	26	29	28	31	27	29	21
Precipitation (water equivalent) (in)	1.45	0.58	2.31	1.62	1.52	1.11	0.46
Snowfall Amount (in)	9.0	4.3	13.9	11.6	14.5	8.0	3.3
Snow on the Ground (in)	5	T	6	10	12	--	--

Natal Harmer Ridge, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	31.5	23.5	8.9	11.8	18.2	23.8	29.2
Ave. Minimum Temp (°F)	23.8	19.2	3.8	5.8	10.8	16.1	21.4
Absolute Min. Temp (°F)	4	5	-27	-17	-17	7	5
No. of days with Freezing Temp.	27	30	31	31	28	31	29
Precipitation (water equivalent) (in)	2.54	0.78	4.96	2.75	2.01	2.36	1.80
Snowfall Amount (in)	24.8	7.8	49.6	27.5	20.1	23.6	17.7
Snow on the Ground (in)	--	--	--	--	--	--	--

Natal Kaiser Resources, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	36.4	30.9	12.8	15.5	21.1	--	38.7
Ave. Minimum Temp (°F)	25.3	24.2	4.2	6.6	9.9	--	28.3
Absolute Min. Temp (°F)	4	5	-32.	-28	-19	--	13
No. of days with Freezing Temp.	25	26	27	30	28	--	24
Precipitation (water equivalent) (in)	1.35	0.20	3.02	1.87	1.22	--	1.85
Snowfall Amount (in)	4.9	1.4	17.5	11.4	11.6	--	3.9
Snow on the Ground (in)	--	--	--	--	--	--	0

Wardner Kootenay Hatchery, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	38.8	32.1	14.7	17.4	25.5	37.9	43.0
Ave. Minimum Temp (°F)	27.0	24.4	6.0	7.3	13.8	26.3	28.2
Absolute Min. Temp (°F)	11	6	-32	-29	-15	16	15
No. of days with Freezing Temp.	24	28	28	31	28	26	22
Precipitation (water equivalent) (in)	0.60	0.36	1.5	1.10	0.98	0.27	0.46
Snowfall Amount (in)	0.2	1.7	4.1	6.0	8.3	T	0.0
Snow on the Ground (in)	--	--	--	--	--	--	0

APPENDIX I (cont'd)

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Aberfeldie, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	38.7	32.6	16.5	14.6	27.2	49.0	40.4
Ave. Minimum Temp (°F)	28.3	25.8	8.5	4.7	17.4	28.8	29.7
Absolute Min. Temp (°F)	7	7	-16	-20	-15	17	22
No. of days with Freezing Temp.	13	22	31	29	27	22	20
Precipitation (water equivalent) (in)	2.40	2.57	3.88	3.78	2.00	0.83	2.57
Snowfall Amount (in)	9.0	7.8	36.7	18.0	7.3	3.4	11.2
Snow on the Ground (in)	--	--	11	14	8	0	0

Canal Flats, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	31.6	32.2	12.7	9.1	23.4	37.7	41.2
Ave. Minimum Temp (°F)	30.0	25.6	4.7	-0.4	12.5	26.8	29.6
Absolute Min. Temp (°F)	1	4	-25	-34	-25	6	19
No. of days with Freezing Temp.	15	26	31	31	28	24	22
Precipitation (water equivalent) (in)	1.58	0.91	3.6	2.77	1.05	1.14	0.93
Snowfall Amount (in)	7.0	2.3	33.4	27.7	7.7	3.8	2.0
Snow on the Ground (in)	--	--	--	--	--	--	--

Cranbrook, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	39.5	30.8	14.1	11.6	25.4	37.4	39.3
Ave. Minimum Temp (°F)	29.1	23.4	5.2	2.0	15.7	27.4	28.9
Absolute Min. Temp (°F)	5	0	-20	-27	-13	11	18
No. of days with Freezing Temp.	17	26	31	31	28	22	21
Precipitation (water equivalent) (in)	0.73	0.95	2.09	1.96	0.73	0.46	1.37
Snowfall Amount (in)	3.0	7.4	31.6	24.9	6.1	4.5	10.6
Snow on the Ground (in)	2	T	13	17	8	0	0

Elko, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	--	32.4	17.8	14.0	26.4	37.7	40.2
Ave. Minimum Temp (°F)	--	26.7	9.7	5.0	17.2	27.9	30.2
Absolute Min. Temp (°F)	4	6	-12	-20	-13	16	21
No. of days with Freezing Temp.	17	23	31	31	27	23	21
Precipitation (water equivalent) (in)	2.01	3.28	3.78	2.44	2.18	1.19	2.13
Snowfall Amount (in)	13.0	14.1	37.8	23.4	12.7	5.1	9.6
Snow on the Ground (in)	6	--	11	--	12	--	--

Eureka, MT (Ranger Sta)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	40.6	35.6	20.3	16.2	29.2	42.0	41.6
Ave. Minimum Temp (°F)	28.3	29.1	12.8	7.7	22.7	31.4	29.4
Absolute Min. Temp (°F)	5	10	-16	-27	-23	19	16
No. of days with Freezing Temp.	19	17	31	29	22	17	20
Precipitation (water equivalent) (in)	0.68	1.10	1.24	2.14	0.72	0.28	0.71
Snowfall Amount (in)	--	3.5	47.5	31.0	--	--	16.0
Snow on the Ground (in)	--	2	--	--	--	--	3

Fernie, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	38.6	31.4	14.0	11.5	24.8	35.7	37.3
Ave. Minimum Temp (°F)	27.6	25.0	4.9	2.1	16.0	26.5	27.4
Absolute Min. Temp (°F)	0	-2	-26	-32	-25	2	12
No. of days with Freezing Temp.	21	25	31	31	26	23	23
Precipitation (water equivalent) (in)	4.5	5.27	9.85	8.82	9.01	4.21	3.72
Snowfall Amount (in)	13.4	20.4	88.9	80.7	46.2	15.2	17.6
Snow on the Ground (in)	12	4	--	47	37	--	--

Fording River Cominco, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	31.9	23.9	7.2	4.8	16.9	26.5	29.2
Ave. Minimum Temp (°F)	21.2	15.8	-4.1	-5.0	6.4	15.4	18.8
Absolute Min. Temp (°F)	-14	-12	-25	-40	-26	-20	-3
No. of days with Freezing Temp.	26	27	31	31	29	27	29
Precipitation (water equivalent) (in)	3.02	1.36	8.02	8.72	5.22	4.84	2.68
Snowfall Amount (in)	20.2	13.6	80.2	87.2	52.2	32.6	25.4
Snow on the Ground (in)	--	--	--	--	--	--	--

Fortine, MT

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	40.1	33.2	19.4	15.5	28.5	39.3	39.6
Ave. Minimum Temp (°F)	26.7	25.5	10.2	6.1	19.9	28.1	27.0
Absolute Min. Temp (°F)	1	5	-18	-28	-22	15	14
No. of days with Freezing Temp.	23	25	31	30	24	23	24
Precipitation (water equivalent) (in)	1.24	1.24	1.84	2.49	1.10	0.88	0.91
Snowfall Amount (in)	2.5	5.0	19.5	34.0	4.0	5.0	3.0
Snow on the Ground (in)	2	2	9	18	16	2	T

Ft. Steele Steeples Ranch, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	39.0	31.9	15.2	12.5	26.6	37.9	38.7
Ave. Minimum Temp (°F)	26.6	24.7	5.8	2.1	17.4	27.4	27.2
Absolute Min. Temp (°F)	2	0	-26	-33	-25	13	14
No. of days with Freezing Temp.	22	24	31	30	--	23	23
Precipitation (water equivalent) (in)	1.43	1.23	2.65	2.55	1.43	0.58	1.40
Snowfall Amount (in)	5.5	3.5	26.5	20.1	2.3	2.5	2.1
Snow on the Ground (in)	--	--	--	--	--	--	--

Grasmere, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	--	35.2	23.5	16.9	35.5	44.7	--
Ave. Minimum Temp (°F)	--	29.0	16.0	10.3	27.6	34.2	--
Absolute Min. Temp (°F)	4	5	-15	-24	-15	20	--
No. of days with Freezing Temp.	13	19	29	29	15	15	--
Precipitation (water equivalent) (in)	1.26	1.06	1.69	1.75	2.8	0.85	--
Snowfall Amount (in)	8.0	4.0	15.7	12.0	T	1.5	--
Snow on the Ground (in)	3	2	12	18	5	0	--

Kimberley, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	38.9	29.5	15.0	12.1	24.4	34.6	36.3
Ave. Minimum Temp (°F)	30.5	22.9	7.3	4.6	16.5	25.8	27.0
Absolute Min. Temp (°F)	5	4	-12	-20	-11	11	13
No. of days with Freezing Temp.	18	26	31	31	27	26	21
Precipitation (water equivalent) (in)	2.38	2.8	6.76	4.94	3.79	2.47	2.47
Snowfall Amount (in)	13.1	24.6	67.6	47.6	28.3	17.0	18.0
Snow on the Ground (in)	9	--	27	41	--	6	--

Kootenay, N.P. (West Gate) BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	38.6	30.1	9.2	8.3	21.6	35.6	40.1
Ave. Minimum Temp (°F)	29.3	24.5	3.2	1.4	13.9	26.4	28.9
Absolute Min. Temp (°F)	4	-2	-26	-23	-15	4	17
No. of days with Freezing Temp.	18	28	31	31	29	23	21
Precipitation (water equivalent) (in)	1.25	0.88	3.18	2.1	2.31	1.41	0.43
Snowfall Amount (in)	6.0	3.5	31.8	21.0	19.4	7.2	0.0
Snow on the Ground (in)	5	0	22	27	32	1	0

Libby Dam, MT

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	42.4	33.9	20.2	16.8	29.2	39.8	42.1
Ave. Minimum Temp (°F)	27.7	25.3	11.4	6.0	19.9	27.5	27.9
Absolute Min. Temp (°F)	7	10	-11	-19	-21	16	17
No. of days with Freezing Temp.	21	25	31	31	28	25	24
Precipitation (water equivalent) (in)	1.14	0.90	2.46	2.24	2.39	1.11	1.08
Snowfall Amount (in)	--	--	(37.8)	(23.3)	3.5	2.0	T
Snow on the Ground (in)	--	--	(16)	(19)[a]	18	12	0

Natal Harmer Ridge, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	30.0	--	8.9	3.3	14.8	24.8	23.3
Ave. Minimum Temp (°F)	21.7	--	2.4	-4.4	7.3	17.3	14.8
Absolute Min. Temp (°F)	-8	-5	-15	-29	-20	1	-2
No. of days with Freezing Temp.	26	30	31	31	29	31	30
Precipitation (water equivalent) (in)	3.56	4.56	5.78	6.05	3.19	1.32	2.4
Snowfall Amount (in)	33.1	45.6	57.8	60.5	31.9	12.7	24.0
Snow on the Ground (in)	--	--	--	--	--	--	--

Natal Kaiser Resources, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	38.1	31.3	14.4	--	22.2	33.6	35.7
Ave. Minimum Temp (°F)	28.5	25.4	5.6	--	11.0	23.6	24.8
Absolute Min. Temp (°F)	-3	-3	-23	--	-25	2	11
No. of days with Freezing Temp.	17	22	31	--	27	27	24
Precipitation (water equivalent) (in)	1.76	1.95	4.36	--	2.04	1.55	2.57
Snowfall Amount (in)	14.1	12.3	40.9	--	17.9	7.6	17.7
Snow on the Ground (in)	--	--	--	--	--	--	--

Wardner Kootenay Hatchery, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	--	33.6	15.3	13.3	28.2	38.6	39.8
Ave. Minimum Temp (°F)	--	25.1	6.2	1.8	17.1	26.6	27.5
Absolute Min. Temp (°F)	--	3	-23	-35	-25	14	15
No. of days with Freezing Temp.	--	24	31	31	25	25	24
Precipitation (water equivalent) (in)	--	1.35	3.46	2.33	1.49	1.18	2.44
Snowfall Amount (in)	--	5.0	28.0	24.3	5.7	7.8	13.6
Snow on the Ground (in)	--	0	--	--	--	--	--

[a] Values in parentheses indicate that measurements were made at the Ranger Station.

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Aberfeldie, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	40.9	28.4	--	20.6	29.1	31.6	44.3
Ave. Minimum Temp (°F)	30.7	20.3	--	12.4	20.2	22.5	32.2
Absolute Min. Temp (°F)	18	-13	--	-11	-1	5	22
No. of days with Freezing Temp.	16	24	--	28	25	29	16
Precipitation (water equivalent) (in)	1.28	1.97	--	3.12	1.26	1.56	0.91
Snowfall Amount (in)	0.0	10.5	--	23.6	3.2	5.2	1.5
Snow on the Ground (in)	0	7	--	--	--	--	0

Canal Flats, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	41.3	28.0	20.0	17.6	27.6	32.4	45.1
Ave. Minimum Temp (°F)	30.8	20.7	13.0	10.8	19.0	23.2	33.1
Absolute Min. Temp (°F)	18	-4	-12	-23	-2	6	22
No. of days with Freezing Temp.	16	25	29	27	25	27	16
Precipitation (water equivalent) (in)	0.79	1.29	2.61	3.00	0.38	0.70	1.05
Snowfall Amount (in)	0.0	9.4	22.6	25.0	2.7	2.0	0.0
Snow on the Ground (in)	0	--	--	0	--	0	0

Cranbrook, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	39.5	26.8	18.9	17.6	26.8	30.1	43.0
Ave. Minimum Temp (°F)	29.3	18.4	11.0	9.5	18.0	21.5	32.0
Absolute Min. Temp (°F)	18	-11	-14	-19	-3	4	23
No. of days with Freezing Temp.	17	30	30	30	27	30	18
Precipitation (water equivalent) (in)	0.55	1.23	1.87	2.67	0.54	1.07	0.83
Snowfall Amount (in)	0.5	16.5	24.9	32.4	5.2	10.0	0.8
Snow on the Ground (in)	0	7	13	11	5	T	0

Elko, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	40.2	28.8	21.5	20.1	28.6	31.5	44.0
Ave. Minimum Temp (°F)	30.3	20.4	13.6	11.7	20.8	23.1	32.8
Absolute Min. Temp (°F)	21	-5	-7	-15	-2	8	20
No. of days with Freezing Temp.	17	26	29	27	24	29	15
Precipitation (water equivalent) (in)	0.98	1.71	3.06	2.73	2.16	1.99	1.05
Snowfall Amount (in)	0.0	9.9	27.7	18.2	18.9	6.6	0.3
Snow on the Ground (in)	0	--	--	--	--	0	0

Eureka, MT (Ranger Sta)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	41.5	29.4	23.8	22.1	31.7	34.8	47.7
Ave. Minimum Temp (°F)	28.7	20.3	16.7	13.8	22.8	25.5	33.9
Absolute Min. Temp (°F)	16	-17	-15	-13	-1	7	21
No. of days with Freezing Temp.	16	26	29	22	23	24	16
Precipitation (water equivalent) (in)	0.40	2.28	1.00	1.76	0.32	0.59	0.80
Snowfall Amount (in)	0.0	--	10.0	--	--	6.5	--
Snow on the Ground (in)	0	--	--	--	--	--	--

Fernie, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	38.8	27.9	20.2	17.7	26.0	27.2	39.1
Ave. Minimum Temp (°F)	27.8	18.5	12.7	9.8	16.9	18.3	27.4
Absolute Min. Temp (°F)	17	-19	-14	-24	-10	-7	11
No. of days with Freezing Temp.	22	25	30	27	24	29	22
Precipitation (water equivalent) (in)	3.20	3.24	6.80	7.65	2.24	4.22	2.63
Snowfall Amount (in)	1.4	11.8	54.0	44.5	16.9	31.5	3.8
Snow on the Ground (in)	0	--	--	--	--	25	0

Fording River Cominco, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	33.1	21.8	13.4	13.1	20.9	19.7	32.7
Ave. Minimum Temp (°F)	20.8	11.1	4.6	4.9	8.6	7.1	20.7
Absolute Min. Temp (°F)	2	-22	-17	-27	-14	-17	-3
No. of days with Freezing Temp.	29	30	31	31	27	31	28
Precipitation (water equivalent) (in)	0.58	2.08	4.88	4.76	1.62	1.48	3.69
Snowfall Amount (in)	1.6	20.8	48.8	43.6	16.2	14.8	13.9
Snow on the Ground (in)	0	--	--	--	--	--	--

Fortine, MT

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	40.5	28.3	23.0	21.7	29.9	32.9	43.7
Ave. Minimum Temp (°F)	27.1	18.5	14.6	13.5	20.3	23.3	29.7
Absolute Min. Temp (°F)	12	-18	-13	-20	-7	4	18
No. of days with Freezing Temp.	18	25	30	24	23	30	20
Precipitation (water equivalent) (in)	0.86	1.84	1.22	1.73	0.51	1.57	0.90
Snowfall Amount (in)	T	14.5	13.5	22.5	3.0	12.0	T
Snow on the Ground (in)	0	7	10	16	3	3	0

Ft. Steele Steeples Ranch, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	38.5	26.9	21.4	18.8	28.3	31.4	42.2
Ave. Minimum Temp (°F)	26.6	17.6	13.4	9.7	19.3	22.6	29.0
Absolute Min. Temp (°F)	13	-15	-20	-20	-9	2	16
No. of days with Freezing Temp.	20	28	29	27	25	27	19
Precipitation (water equivalent) (in)	0.75	1.10	2.14	2.89	0.84	0.84	0.89
Snowfall Amount (in)	0.0	6.3	20.1	26.4	3.4	4.1	0.0
Snow on the Ground (in)	0	--	--	0	T	0	0

Grasmere, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	39.6	31.3	23.0	26.7	30.0	34.3	46.6
Ave. Minimum Temp (°F)	28.9	24.3	15.8	20.4	21.1	24.6	31.8
Absolute Min. Temp (°F)	18	-14	-5	-14	-2	15	22
No. of days with Freezing Temp.	19	21	29	25	--	31	18
Precipitation (water equivalent) (in)	0.05	1.83	2.29	1.68	--	0.80	0.81
Snowfall Amount (in)	0.0	14.0	19.0	10.5	--	8.0	0.0
Snow on the Ground (in)	0	8	10	5	--	0	0

Kimberley, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	--	26.6	19.0	18.1	25.5	26.6	--
Ave. Minimum Temp (°F)	--	18.9	11.9	10.4	16.7	17.3	29.8
Absolute Min. Temp (°F)	16	-8	-8	-12	0	5	17
No. of days with Freezing Temp.	26	30	31	30	28	31	18
Precipitation (water equivalent) (in)	0.74	2.40	6.56	6.83	2.03	2.74	2.01
Snowfall Amount (in)	0.4	17.4	61.9	57.3	13.9	27.4	T
Snow on the Ground (in)	0	--	28	31	30	27	0

Kootenay N.P. (West Gate) BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	38.9	25.1	16.9	15.6	25.3	30.9	43.7
Ave. Minimum Temp (°F)	30.0	19.2	10.5	9.7	17.7	21.8	32.0
Absolute Min. Temp (°F)	18	-6	-12	-21	-3	4	21
No. of days with Freezing Temp.	18	30	31	30	25	31	17
Precipitation (water equivalent) (in)	1.47	1.63	1.42	2.80	0.33	0.91	1.06
Snowfall Amount (in)	T	10.6	12.4	17.9	3.0	4.8	0.0
Snow on the Ground (in)	0	6	12	15	13	5	0

Libby Dam, MT

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	41.5	29.7	21.8	21.8	30.5	33.8	44.8
Ave. Minimum Temp (°F)	27.5	20.1	13.0	13.9	20.7	23.3	31.1
Absolute Min. Temp (°F)	16	-7	-4	-14	1	8	22
No. of days with Freezing Temp.	18	30	31	29	25	30	17
Precipitation (water equivalent) (in)	1.82	1.44	1.39	3.33	0.94	1.39	1.14
Snowfall Amount (in)	(T)	(10.5)	(35.0)	(29.4)	(4.4)	(9.0)	(0.0)
Snow on the Ground (in)	(0)	(7)	(17)	(31)	(12)	(8)	(0)*

Natal Kaiser Resources, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	--	24.6	19.2	15.2	25.3	26.7	41.5
Ave. Minimum Temp (°F)	--	11.9	10.9	6.5	15.4	17.5	29.8
Absolute Min. Temp (°F)	--	-26	-8	-25	-12	-8	12
No. of days with Freezing Temp.	12	29	31	28	24	31	17
Precipitation (water equivalent) (in)	--	2.60	3.90	10.25	1.44	1.33	0.39
Snowfall Amount (in)	--	16.3	37.1	37.0	11.0	11.8	T
Snow on the Ground (in)	--	11	--	--	--	--	0

WASA, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)							
Ave. Minimum Temp (°F)							
Absolute Min. Temp (°F)							
No. of days with Freezing Temp.							
Precipitation (water equivalent) (in)	1.32	1.58	1.26	2.51	0.42	0.45	1.54
Snowfall Amount (in)	T	12.9	12.5	22.5	1.5	4.1	1.4
Snow on the Ground (in)	0	4	5	7	3	0	0

*Value in parentheses indicate that measurements were made at the Ranger Station.

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Aberfeldie, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	40.6	34.2	22.6	16.6	28.8	33.6	40.9
Ave. Minimum Temp (°F)	30.5	26.7	17.3	7.2	19.4	22.6	32.1
Absolute Min. Temp (°F)	17	15	-4	-11	13	-2	20
No. of days with Freezing Temp.	18	23	30	31	26	30	18
Precipitation (water equivalent) (in)	0.84	0.27	1.63	2.31	0.77	0.57	0.93
Snowfall Amount (in)	1.5	0.2	10.3	18.0	0.8	2.2	0.0
Snow on the Ground (in)	0	0	5	10	2	0	0

Canal Flats, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	41.2	33.7	20.3	13.1	25.2	32.5	41.2
Ave. Minimum Temp (°F)	31.3	27.5	14.8	4.0	15.1	21.1	30.5
Absolute Min. Temp (°F)	19	10	-7	-22	-2	-11	24
No. of days with Freezing Temp.	15	20	31	31	28	29	20
Precipitation (water equivalent) (in)	0.39	0.37	1.06	1.79	0.72	0.39	0.32
Snowfall Amount (in)	2.0	T	10.6	17.7	6.9	0.9	1.9
Snow on the Ground (in)	0	0	--	--	--	--	0

Cranbrook, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	39.6	33.0	19.8	13.6	26.9	31.8	39.6
Ave. Minimum Temp (°F)	29.4	26.2	13.4	4.8	17.5	21.2	30.5
Absolute Min. Temp (°F)	15	11	-6	-20	2	-8	21
No. of days with Freezing Temp.	20	24	31	31	27	30	22
Precipitation (water equivalent) (in)	0.41	0.11	1.31	1.58	0.47	0.40	0.86
Snowfall Amount (in)	3.7	T	15.4	19.7	4.7	3.5	4.8
Snow on the Ground (in)	0	0	7	17	13	0	0

Elko, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	40.6	33.9	23.5	16.5	29.4	32.4	40.0
Ave. Minimum Temp (°F)	31.9	27.3	18.9	8.2	21.6	22.1	31.4
Absolute Min. Temp (°F)	22	14	2	-10	14	-1	25
No. of days with Freezing Temp.	16	23	30	31	28	29	22
Precipitation (water equivalent) (in)	0.88	0.43	1.53	3.32	0.95	1.19	0.67
Snowfall Amount (in)	2.2	2.4	12.5	29.6	4.1	8.2	3.1
Snow on the Ground (in)	0	1	6	16	10	0	0

Eureka, MT (Ranger Sta)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	39.4	35.5	23.7	17.2	30.4	35.1	40.6
Ave. Minimum Temp (°F)	28.6	27.5	18.2	9.6	23.0	23.5	30.2
Absolute Min. Temp (°F)	13	10	-7	-23	12	-6	18
No. of days with Freezing Temp.	20	22	31	31	24	25	19
Precipitation (water equivalent) (in)	0.81	0.06	1.31	1.75	0.92	0.46	0.11
Snowfall Amount (in)	0.0	1.0	--	--	--	8.5	0.0
Snow on the Ground (in)	0	--	--	--	--	--	0

Fernie, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	39.5	34.0	24.4	16.1	27.8	29.8	37.2
Ave. Minimum Temp (°F)	30.5	27.2	18.4	7.6	18.1	19.3	28.7
Absolute Min. Temp (°F)	16	10	-5	-23	2	-7	18
No. of days with Freezing Temp.	19	20	29	31	27	29	23
Precipitation (water equivalent) (in)	1.32	1.06	1.98	6.03	1.57	1.67	4.0
Snowfall Amount (in)	2.4	2.0	11.3	49.9	9.2	4.9	8.3
Snow on the Ground (in)	0	--	7	--	--	--	--

Fording River Cominco, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)					26.0	25.0	30.3
Ave. Minimum Temp (°F)					10.8	8.4	19.8
Absolute Min. Temp (°F)					-4	-17	1
No. of days with Freezing Temp.					28	31	30
Precipitation (water equivalent) (in)					1.03	1.27	1.86
Snowfall Amount (in)					10.3	12.7	18.6
Snow on the Ground (in)					--	--	--

Fortine, MT

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	39.7	34.3	24.8	18.9	29.7	33.3	39.5
Ave. Minimum Temp (°F)	28.6	25.4	19.3	10.5	20.4	21.6	29.2
Absolute Min. Temp (°F)	12	6	-6	-21	10	-5	16
No. of days with Freezing Temp.	19	3	30	30	26	27	22
Precipitation (water equivalent) (in)	0.83	0.24	1.49	2.18	0.88	0.74	0.19
Snowfall Amount (in)	3.0	5.0	9.8	21.5	5.5	6.5	T
Snow on the Ground (in)	1	5	5	12	12	10	0

Ft. Steele Steeples Ranch, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	39.5	33.6	22.0	14.7	27.8	32.6	39.9
Ave. Minimum Temp (°F)	28.5	26.1	15.9	5.4	18.1	21.3	29.4
Absolute Min. Temp (°F)	13	10	-8	-21	4	-10	18
No. of days with Freezing Temp.	20	21	30	30	28	28	19
Precipitation (water equivalent) (in)	0.42	0.23	0.56	3.29	0.52	0.67	0.87
Snowfall Amount (in)	1.0	T	5.6	28.4	1.4	2.8	0.5
Snow on the Ground (in)	0	0	--	11	--	0	0

Grasmere, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	40.4	34.1	22.2	20.3	31.0	--	40.9
Ave. Minimum Temp (°F)	31.0	27.6	18.2	12.4	23.4	--	32.2
Absolute Min. Temp (°F)	15	13	-1	-15	12	-1	20
No. of days with Freezing Temp.	14	22	26	31	24	--	19
Precipitation (water equivalent) (in)	0.81	0.16	1.18	0.50	0.98	0.80	0.13
Snowfall Amount (in)	2.5	0.5	9.0	5.0	5.0	7.0	T
Snow on the Ground (in)	0	0	8	11	12	0	0

Kimberley, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	39.3	32.9	20.6	15.6	27.1	30.7	37.6
Ave. Minimum Temp (°F)	31.2	26.5	14.6	7.8	19.4	21.6	29.9
Absolute Min. Temp (°F)	18	8	0	-12	6	0	20
No. of days with Freezing Temp.	17	23	31	31	28	29	18
Precipitation (water equivalent) (in)	0.97	1.27	2.30	3.44	1.45	1.43	1.51
Snowfall Amount (in)	7.8	2.4	19.0	33.3	14.5	14.3	6.9
Snow on the Ground (in)	0	1	10	26	--	--	0

Kootenay N.P. (West Gate) BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	40.1	31.7	19.4	11.9	25.7	32.6	39.9
Ave. Minimum Temp (°F)	31.3	26.8	14.5	5.1	17.1	22.6	29.4
Absolute Min. Temp (°F)	18	12	-2	-21	6	-3	22
No. of days with Freezing Temp.	16	22	31	31	28	29	26
Precipitation (water equivalent) (in)	0.65	0.62	0.75	1.97	0.53	0.15	0.19
Snowfall Amount (in)	1.4	T	4.6	19.7	5.3	1.5	T
Snow on the Ground (in)	0	0	3	14	14	0	0

Libby Dam, MT.

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	39.6	33.0	25.9	19.5	30.1	33.4	40.4
Ave. Minimum Temp (°F)	28.1	23.4	20.2	10.5	18.6	18.7	28.7
Absolute Min. Temp (°F)	17	12	12	-12	9	1	19
No. of days with Freezing Temp.	24	29	31	31	28	31	24
Precipitation (water equivalent) (in)	0.98	0.11	1.36	2.78	0.94	0.81	0.94
Snowfall Amount (in)	0.0	--	(12.1)	(27.5)	(1.0)	(6.1)	(0.0)*
Snow on the Ground (in)	0	--	(9)	(20)	(17)	(17)	(0)

Natal Kaiser Resources, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	--	--	--	--	25.4	26.5	37.1
Ave. Minimum Temp (°F)	--	--	--	3.9	14.6	14.1	29.4
Absolute Min. Temp (°F)	6	--	--	-24	0	-14	13
No. of days with Freezing Temp.	--	--	--	30	28	30	20
Precipitation (water equivalent) (in)	0.85	--	--	3.45	0.42	--	1.61
Snowfall Amount (in)	1.8	--	--	34.5	4.2	--	9.0
Snow on the Ground (in)	--	--	--	--	--	--	0

WASA, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)							
Ave. Minimum Temp (°F)							
Absolute Min. Temp (°F)							
No. of days with Freezing Temp.							
Precipitation (water equivalent) (in)	0.42	0.18	0.68	1.63	0.59	0.41	1.25
Snowfall Amount (in)	1.8	0.0	6.4	15.8	5.9	2.2	4.1
Snow on the Ground (in)	0	0	4	10	--	--	0

*Value in parentheses indicate that measurements were made at the Ranger Station.

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Aberfeldie, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	43.2	34.4	16.9	7.7	23.9	34.9	46.0
Ave. Minimum Temp (°F)	34.5	28.3	11.6	-0.1	13.4	23.1	35.0
Absolute Min. Temp (°F)	25	16	-34	-28	-21	9	28
No. of days with Freezing Temp.	13	22	29	31	27	26	8
Precipitation (water equivalent) (in)	2.05	1.76	4.57	3.95	1.25	0.43	2.98
Snowfall Amount (in)	0.0	3.5	33.6	39.5	10.5	0.0	0.3
Snow on the Ground (in)	0	1	20	34	17	4	T

Canal Flats, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	43.0	32.1	14.9	1.1	19.5	33.0	46.7
Ave. Minimum Temp (°F)	33.3	25.5	9.4	-8.0	8.2	21.1	35.4
Absolute Min. Temp (°F)	--	13	-43	-37	-24	2	28
No. of days with Freezing Temp.	--	26	31	31	28	25	9
Precipitation (water equivalent) (in)	0.97	1.18	3.43	3.65	1.18	0.05	1.94
Snowfall Amount (in)	0.0	6.5	29.1	36.5	11.8	0.5	T
Snow on the Ground (in)	0	--	--	--	--	0	0

Cranbrook, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	41.2	30.4	13.8	3.5	21.4	32.4	--
Ave. Minimum Temp (°F)	31.4	24.0	6.6	-5.3	11.3	20.5	--
Absolute Min. Temp (°F)	21	10	-40	-29	-19	6	--
No. of days with Freezing Temp.	18	29	31	31	28	28	--
Precipitation (water equivalent) (in)	1.11	1.23	4.69	3.96	0.78	0.49	--
Snowfall Amount (in)	0.0	11.9	41.9	39.6	7.8	4.9	--
Snow on the Ground (in)	0	2	13	29	24	3	1

Elko, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	42.5	32.6	16.4	7.6	23.8	34.2	46.4
Ave. Minimum Temp (°F)	34.5	26.3	10.7	-0.2	14.1	23.2	35.2
Absolute Min. Temp (°F)	27	19	-29	-24	-5	8	28
No. of days with Freezing Temp.	13	25	30	31	28	25	13
Precipitation (water equivalent) (in)	2.17	1.62	3.92	2.39	1.20	0.66	3.23
Snowfall Amount (in)	0.0	7.7	30.8	23.0	11.3	3.9	1.8
Snow on the Ground (in)	0	0	14	10	9	0	--

Eureka, MT (Ranger Sta)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	41.0	33.2	17.2	10.4	23.9	37.3	52.3
Ave. Minimum Temp (°F)	29.6	24.6	9.3	1.4	13.0	24.0	37.7
Absolute Min. Temp (°F)	20	17	-50	-34	-13	4	30
No. of days with Freezing Temp.	21	26	31	30	27	23	8
Precipitation (water equivalent) (in)	0.82	0.85	1.51	2.77	0.68	0.48	1.12
Snowfall Amount (in)	--	--	20.5	47.5	1.5	3.0	0.0
Snow on the Ground (in)	--	--	--	--	--	--	0

Fernie, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	41.4	32.3	14.2	4.9	22.4	31.9	43.5
Ave. Minimum Temp (°F)	33.5	26.9	8.2	-1.5	12.6	21.5	33.4
Absolute Min. Temp (°F)	24	8	-43	-33	-6	4	27
No. of days with Freezing Temp.	13	22	31	31	28	27	17
Precipitation (water equivalent) (in)	5.38	5.14	9.52	9.01	1.62	1.99	3.56
Snowfall Amount (in)	T	6.7	73.0	85.3	15.6	6.2	3.0
Snow on the Ground (in)	0	--	28	--	--	18	--

Fortine, MT

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	42.6	32.4	17.4	8.9	23.8	33.3	46.1
Ave. Minimum Temp (°F)	31.5	25.0	9.5	0.4	12.4	19.2	32.4
Absolute Min. Temp (°F)	20	13	-49	-32	-7	-1	25
No. of days with Freezing Temp.	17	28	30	31	28	27	15
Precipitation (water equivalent) (in)	1.75	1.44	2.27	2.71	0.87	0.39	1.62
Snowfall Amount (in)	0.0	3.0	22.5	37.0	10.0	1.0	T
Snow on the Ground (in)	0	1	14	28	28	20	0

Ft. Steele Steeples Ranch, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)				5.6	20.9	31.5	45.2
Ave. Minimum Temp (°F)				-3.4	9.0	18.2	33.1
Absolute Min. Temp (°F)				-42	-25	-6	25
No. of days with Freezing Temp.				31	28	27	16
Precipitation (water equivalent) (in)				3.24	1.00	T	2.28
Snowfall Amount (in)				32.4	9.2	T	T
Snow on the Ground (in)				29	23	T	0

Grasmere, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	43.0	35.1	17.7	10.0	27.8	35.5	49.7
Ave. Minimum Temp (°F)	33.4	28.9	10.9	2.5	18.4	23.1	36.5
Absolute Min. Temp (°F)	23	18	-45	-27	-4	2	28
No. of days with Freezing Temp.	13	23	29	29	28	24	7
Precipitation (water equivalent) (in)	1.52	1.00	3.20	3.12	0.45	0.69	2.72
Snowfall Amount (in)	0.0	5.5	27.5	26.5	4.0	1.0	0.0
Snow on the Ground (in)	0	0	19	34	25	--	0

Kimberley, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	40.3	29.3	13.8	6.3	23.1	32.6	43.3
Ave. Minimum Temp (°F)	32.1	22.9	7.5	-1.3	14.7	23.3	33.6
Absolute Min. Temp (°F)	27	12	-35	-22	-13	10	26
No. of days with Freezing Temp.	19	29	31	31	28	29	13
Precipitation (water equivalent) (in)	1.65	2.56	5.53	5.01	2.15	1.57	2.99
Snowfall Amount (in)	T	22.9	52.9	49.9	21.5	14.7	7.1
Snow on the Ground (in)	0	12	31	36	38	19	--

Kootenay, N.P. (West Gate) BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	40.0	29.3	--	--	21.3	35.1	46.5
Ave. Minimum Temp (°F)	31.0	22.4	--	-4.2	11.4	24.3	35.3
Absolute Min. Temp (°F)	--	--	--	-32	-12	9	28
No. of days with Freezing Temp.	--	29	--	31	28	25	12
Precipitation (water equivalent) (in)	0.69	0.70	--	1.52	0.67	0.10	2.45
Snowfall Amount (in)	0.0	2.5	--	15.2	6.7	1.0	T
Snow on the Ground (in)	0	1	--	24	24	0	0

Libby 1NE, MT

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	43.3	34.7	19.9	14.6	28.9	37.1	47.9
Ave. Minimum Temp (°F)	33.0	27.5	12.7	6.6	18.4	22.0	32.0
Absolute Min. Temp (°F)	21	20	-39	-21	2	3	25
No. of days with Freezing Temp.	13	28	31	31	27	30	18
Precipitation (water equivalent) (in)	1.65	2.36	2.78	4.52	0.70	0.86	0.61
Snowfall Amount (in)	0.0	6.8	28.8	51.5	1.8	T	0.0
Snow on the Ground (in)	0	5	19	34	32	21	0

WASA, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)							
Ave. Minimum Temp (°F)							
Absolute Min. Temp (°F)							
No. of days with Freezing Temp.							
Precipitation (water equivalent) (in)	1.25	1.73	2.83	2.39	0.50	0.20	2.46
Snowfall Amount (in)	0.0	10.7	24.3	23.9	5.0	1.0	3.3
Snow on the Ground (in)	0	0	13	25	24	5	3

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	Aberfeldie, BC							Canal Flats, BC							Cranbrook, BC						
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	45.7	32.9	24.6		33.8	41.3	41.7	44.8	29.6	18.9		30.9	39.4	40.5	45.1	29.3	20.4		30.4	38.9	39.4
Ave. Minimum Temp (°F)	37.1	26.2	19.0		24	31.5	31.1	36.4	22.0	11.5		20.0	29.1	29.6	35.6	29.8	13.3		19.5	29.6	28.1
Absolute Min. Temp (°F)	26	9	-4		10	23	14	23	3	-19		2	21	18	20	2	-14		2	22	14
No. of days with Freezing Temp.	7	23	27		21	17	19	10	26	31		25	13	13	13	27	29		26	23	25
Precipitation (water equivalent) (in)	2.45	0.70	1.93		1.00	1.30	1.64	1.10	0.23	1.76		0.18	0.65	5.0	1.43	0.61	1.71		0.47	0.50	0.46
Snowfall Amount (in)	0.0	1.4	11.4		0.6	0.8	7.9	0.0	1.6	12.8		T	0.2	0.0	2.0	2.8	16.6		0.7	1.0	2.7
Snow on the Ground (in)	0	T	--		0	0	0	0	--	5		0	0	0	0	--	T		0	0	0

	Elko, BC							Eureka, MT (Ranger Sta)							Fernie, BC						
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	45.0	31.8	23.7		33.1	40.0	40.8	47.0	30.6	24.4	25.2	34.2	42.6	45.2	44.3	31.6	20.7		31.1	27.8	38.4
Ave. Minimum Temp (°F)	36.5	25.0	18.3		24.8	30.4	30.2	35.5	19.6	--	17.4	23.3	29.7	32.0	36.6	25.7	14.3		20.0	29.5	28.8
Absolute Min. Temp (°F)	25	6	-1		11	23	16	22	0	--	-23	6	20	16	26	5	-10		3	22	7
No. of days with Freezing Temp.	9	25	31		21	18	19	8	30	--	27	20	21	19	8	20	30		21	18	21
Precipitation (water equivalent) (in)	2.72	1.06	1.81		0.85	0.96	1.33	1.72	0.33	0.96	1.10	0.27	0.34	0.48	6.48	3.25	5.91		3.15	4.53	2.45
Snowfall Amount (in)	0.7	5.1	16.1		1.2	4.0	6.5	0.0	T	--	15	1	1.0	0.0	1.3	14.0	33.1		[illegible]	8.5	10.8
Snow on the Ground (in)	0	--	--		0	0	0	--	0	--	12	4	1	0	0	--	--		--	--	0

	Fortine, MT							Ft. Steele Steeples Ranch, BC							Grasmere, BC						
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	45.1	30.9	23.4	23.5	32.2	39.4	40.7	43.2	29.5						46.1	30.3	23.6		32.8	38.7	41.3
Ave. Minimum Temp (°F)	34.3	22.1	--	15.4	21.4	26.7	28.3	33.2	21.1						36.7	24.9	17.9		22.8	28.1	29.9
Absolute Min. Temp (°F)	19	3	--	-21	3	17	13	21	3						24	4	-4		5	20	13
No. of days with Freezing Temp.	10	25	--	28	22	24	21	15	29						9	22	27		21	21	20
Precipitation (water equivalent) (in)	1.97	0.47	1.07	0.86	0.60	0.61	0.83	1.59	0.39						2.44	0.23	1.57		0.84	1.13	0.84
Snowfall Amount (in)	0.0	2.0	--	7	2.5	2	1.0	T	0.7						0.0	0.5	11.2		2.5	2.0	0.2
Snow on the Ground (in)	0	1	--	5	5	2	T	0	--						0	T	--		0	0	0

	Kimberley, BC							Kootenay N.P. (West Gate) BC							Libby 1NE, MT						
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	41.9	29.3	19.7		30.1	37.2	--	42.4	27.6	18.1		30.1	37.5	38.2	48.5	35.1	25.0	25.3	33.6	41.4	43.5
Ave. Minimum Temp (°F)	33.9	23.4	13.2		21.1	28.2	--	33.8	22.2	12.4		21.1	27.9	27.7	36.4	25.2	--	17.6	21.8	27.6	28.0
Absolute Min. Temp (°F)	25	6	-15		6	20	--	23	3	-12		4	--	16	24	10	--	-13	2	18	18
No. of days with Freezing Temp.	11	26	31		27	26	25	18	26	31		24	--	25	--	22	--	29	24	23	23
Precipitation (water equivalent) (in)	4.95	0.79	3.76		1.43	1.76	0.99	1.10	0.74	1.62		0.59	1.12	2.58	2.69	1.01	2.19	2.24	1.55	1.10	0.81
Snowfall Amount (in)	2.3	3.7	36.1		11.5	8.9	8.0	0.4	6.5	13.6		3.2	5.3	19.0	0.0	5.0	--	22.5	1.0	0	0.0
Snow on the Ground (in)	0	3	15		15	0	0	0	4	9		0	--	--	0	--	--	13	12	0	0

	Natal Kaiser Resources, BC							WASA, BC						
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	41.5	29.3	18.5		29.7	35.7	35.6							
Ave. Minimum Temp (°F)	32.6	21.5	10.7		19.2	26.2	24.9							
Absolute Min. Temp (°F)	20	-2	-21		-6	15	-4							
No. of days with Freezing Temp.	15	26	31		23	27	24							
Precipitation (water equivalent) (in)	3.66	0.88	4.19		0.88	2.30	2.17	1.40	0.22	0.99		1.06	0.42	1.04
Snowfall Amount (in)	6.7	4.1	36.7		4.9	8.6	21.7	1.0	0.5	9.0		0	0.1	2.6
Snow on the Ground (in)	0	2	9		0	1	0	0	0	2		0	0	0

*Climatic data book for the British Columbia stations for January 1968 was missing.

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Aberfeldie, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (^oF)	44.5	33.7	30.7	30.2	32.6	31.9	41.9
Ave. Minimum Temp (^oF)	34.3	27.6	25.7	23.7	23.7	24.4	32.0
Absolute Min. Temp (^oF)	25	10	10	0	9	4	20
No. of days with Freezing Temp.	14	21	24	25	23	24	15
Precipitation (water equivalent) (in)	1.64	3.26	1.90	3.56	1.00	1.37	0.68
Snowfall Amount (in)	T	4.4	4.0	9.1	8.1	5.9	0.0
Snow on the Ground (in)	0	--	--	--	0	--	0

Canal Flats, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (^oF)	43.8	30.2	27.7	24.8	28.9	31.4	41.1
Ave. Minimum Temp (^oF)	33.7	23.2	22.0	16.4	19.5	23.4	28.6
Absolute Min. Temp (^oF)	22	2	-2	-15	2	3	21
No. of days with Freezing Temp.	16	28	27	28	26	27	23
Precipitation (water equivalent) (in)	1.48	2.37	0.85	2.11	0.61	1.58	0.08
Snowfall Amount (in)	0.2	12.6	3.7	10.3	5.1	7.7	T
Snow on the Ground (in)	0	--	--	--	0	--	0

Cranbrook, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (^oF)	42.9	30.8	27.3	26.5	29.6	29.0	39.3
Ave. Minimum Temp (^oF)	31.9	22.9	20.8	18.0	20.1	19.5	28.0
Absolute Min. Temp (^oF)	23	3	-1	-3	5	-6	16
No. of days with Freezing Temp.	17	27	27	29	23	30	23
Precipitation (water equivalent) (in)	1.30	3.16	1.61	2.87	0.72	2.64	0.67
Snowfall Amount (in)	2.3	16.5	7.1	17.3	7.2	19.1	1.1
Snow on the Ground (in)	0	2	0	0	0	0	0

Elko, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (^oF)	43.1	31.0	28.8	28.9	31.0	30.0	40.5
Ave. Minimum Temp (^oF)	32.6	24.6	23.5	22.2	22.9	22.6	30.6
Absolute Min. Temp (^oF)	22	6	8	-1	10	5	20
No. of days with Freezing Temp.	16	28	27	26	23	25	18
Precipitation (water equivalent) (in)	1.89	3.17	2.56	3.18	1.97	1.96	0.08
Snowfall Amount (in)	4.1	8.4	9.6	15.1	18.0	15.6	2.4
Snow on the Ground (in)	0	--	--	--	--	--	--

Eureka, MT (Ranger Sta)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (^oF)	45.7	34.1	29.0	32.1	33.0	33.2	42.1
Ave. Minimum Temp (^oF)	33.4	26.5	23.9	25.9	24.4	23.5	29.7
Absolute Min. Temp (^oF)	22	4	6	2	3	-7	20
No. of days with Freezing Temp.	17	24	24	24	22	24	22
Precipitation (water equivalent) (in)	1.08	2.69	1.37	1.20	0.74	1.33	.0.26
Snowfall Amount (in)	0.8	10.7	11.7	5.3	6.3	13.6	1.8
Snow on the Ground (in)	0	4	7	1	4	3	0

Fernie, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (^oF)	42.2	29.7	27.7	25.7	28.5	26.5	37.0
Ave. Minimum Temp (^oF)	33.0	23.8	22.4	18.0	20.4	19.2	28.2
Absolute Min. Temp (^oF)	24	7	-1	-3	1	-5	11
No. of days with Freezing Temp.	14	25	25	26	21	27	27
Precipitation (water equivalent) (in)	3.83	8.03	7.34	10.41	3.98	4.63	1.08
Snowfall Amount (in)	6.5	34.5	18.8	53.5	22.0	31.2	2.5
Snow on the Ground (in)	0	12	--	25	28	33	0

Fortine, MT

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (^oF)	43.4	32.6	29.6	29.6	30.6	30.6	39.3
Ave. Minimum Temp (^oF)	30.4	24.3	24.3	22.7	20.9	20.8	27.1
Absolute Min. Temp (^oF)	19	0	8	1	1	-8	16
No. of days with Freezing Temp.	18	26	23	28	26	29	25
Precipitation (water equivalent) (in)	1.15	3.01	1.24	1.32	0.73	1.03	0.42
Snowfall Amount (in)	0.5	9.5	10.5	4.0	4.5	10.5	0.5
Snow on the Ground (in)	T	6	8	2	4	4	T

Ft. Steele Steeples Ranch, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (^oF)	--	31.8	28.5	27.8	30.4	30.9	39.9
Ave. Minimum Temp (^oF)	--	24.8	22.4	19.9	20.8	22.6	28.2
Absolute Min. Temp (^oF)	--	6	3	4	6	0	17
No. of days with Freezing Temp.	--	26	26	30	24	27	22
Precipitation (water equivalent) (in)	--	1.49	0.15	1.73	0.35	1.83	0.34
Snowfall Amount (in)	--	4.2	0.2	6.5	3.5	7.2	0.6
Snow on the Ground (in)	--	--	T	0	0	0	0

Grasmere, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (^oF)	44.3	32.9	32.5	31.6	33.7	30.3	40.8
Ave. Minimum Temp (^oF)	33.0	27.3	27.4	25.6	25.4	23.1	29.4
Absolute Min. Temp (^oF)	23	5	10	3	16	0	19
No. of days with Freezing Temp.	20	20	19	26	24	28	21
Precipitation (water equivalent) (in)	1.4	2.38	0.73	1.48	0.84	1.04	0.49
Snowfall Amount (in)	2.0	6.5	6.0	3.0	8.0	9.5	T
Snow on the Ground (in)	0	4	1	0	0	0	0

Kimberley, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (^oF)	41.6	30.3	25.4	24.4	27.9	27.0	37.6
Ave. Minimum Temp (^oF)	33.5	23.9	20.0	17.0	19.8	18.0	28.5
Absolute Min. Temp (^oF)	24	7	5	-2	10	0	15
No. of days with Freezing Temp.	14	27	30	30	27	30	27
Precipitation (water equivalent) (in)	3.01	4.63	2.69	4.27	1.40	4.43	0.49
Snowfall Amount (in)	2.2	31.2	23.6	36.0	7.0	28.0	0.5
Snow on the Ground (in)	0	(2)	(2)	--	18	20	0

Kootenay, N.P. (West Gate) BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (^oF)	40.7	28.8	24.9	22.5	26.3	29.7	40.0
Ave. Minimum Temp (^oF)	31.5	23.7	19.6	15.9	18.2	21.6	28.8
Absolute Min. Temp (^oF)	21	6	1	-3	8	3	20
No. of days with Freezing Temp.	20	29	30	31	27	29	24
Precipitation (water equivalent) (in)	1.28	2.44	1.02	2.99	0.99	0.70	0.13
Snowfall Amount (in)	6.1	17.2	7.2	20.1	7.5	6.7	0.9
Snow on the Ground (in)	0	4	3	8	9	1	0

Libby 1NE, MT

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (^oF)	45.9	34.0	29.6	28.4	35.5	35.9	42.5
Ave. Minimum Temp (^oF)	33.1	27.5	25.1	22.8	24.8	25.5	28.6
Absolute Min. Temp (^oF)	19	12	12	0	12	11	20
No. of days with Freezing Temp.	15	28	26	29	26	27	23
Precipitation (water equivalent) (in)	1.38	3.67	2.29	4.83	1.25	1.33	1.21
Snowfall Amount (in)	T	7.5	15.6	30.0	2.6	--	--
Snow on the Ground (in)	0	4	6	23	4	1	--

Natal Kaiser Resources, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (^oF)	41.3	27.3	26.2	23.5	25.2	23.3	35.1
Ave. Minimum Temp (^oF)	31.4	18.9	19.7	14.3	15.2	14.1	24.2
Absolute Min. Temp (^oF)	15	-6	-11	-20	-10	-18	-14
No. of days with Freezing Temp.	18	28	26	30	25	28	29
Precipitation (water equivalent) (in)	2.32	4.19	2.44	4.90	2.72	3.78	1.33
Snowfall Amount (in)	7.0	24.7	10.4	29.7	13.5	29.1	8.8
Snow on the Ground (in)	0	8	2	5	2	2	--

WASA, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (^oF)							
Ave. Minimum Temp (^oF)							
Absolute Min. Temp (^oF)							
No. of days with Freezing Temp.							
Precipitation (water equivalent) (in)	--	3.00	0.50	1.09	0.70	1.15	0.05
Snowfall Amount (in)	T	10.6	3.0	7.0	0.6	8.7	0.0
Snow on the Ground (in)	0	--	--	--	0	0	0

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Aberfeldie, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	47.9	32.4	26.6	23.1	--	--	43.3
Ave. Minimum Temp (°F)	35.9	25.9	20.9	17.9	21.7	26.7	32.6
Absolute Min. Temp (°F)	26	4	0	-9	-1	3	22
No. of days with Freezing Temp.	13	23	28	27	28	20	15
Precipitation (water equivalent) (in)	--	2.47	3.52	4.25	0.84	0.62	0.01
Snowfall Amount (in)	0.0	12.5	29.0	35.7	8.4	1.6	T
Snow on the Ground (in)	0	--	--	--	--	0	0

Canal Flats, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	--	--	22.2	19.5	24.2	34.3	43.1
Ave. Minimum Temp (°F)	--	--	15.3	11.7	13.0	23.7	31.4
Absolute Min. Temp (°F)	23	--	-4	-13	0	-4	21
No. of days with Freezing Temp.	17	--	29	31	28	28	19
Precipitation (water equivalent) (in)	0.30	1.11	2.75	1.90	0.35	0.35	0.81
Snowfall Amount (in)	0.0	7.3	27.5	15.5	3.5	3.5	T
Snow on the Ground (in)	0	--	--	--	--	0	0

Cranbrook, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	45.4	28.9	22.9	19.6	24.8	33.1	41.0
Ave. Minimum Temp (°F)	32.2	20.5	15.1	12.3	13.7	22.3	29.2
Absolute Min. Temp (°F)	22	-7	-8	-12	-8	-5	15
No. of days with Freezing Temp.	18	26	31	28	28	27	21
Precipitation (water equivalent) (in)	0.29	2.06	3.71	3.63	0.85	2.08	0.97
Snowfall Amount (in)	0.0	15.7	34.9	32.4	8.5	16.2	2.6
Snow on the Ground (in)	0	4	8	12	(1)	0	0

Elko, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	46.6	30.9	24.9	21.0	27.3	33.6	41.2
Ave. Minimum Temp (°F)	34.7	24.6	18.4	14.5	18.1	23.0	30.2
Absolute Min. Temp (°F)	26	4	-4	-15	-4	-2	16
No. of days with Freezing Temp.	15	23	30	30	28	29	21
Precipitation (water equivalent) (in)	0.87	2.64	3.20	3.27	0.93	1.01	1.22
Snowfall Amount (in)	0.0	11.4	28.8	30.7	9.1	4.2	0.4
Snow on the Ground (in)	0	--	--	--	--	0	0

Eureka, MT (Ranger Sta)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	48.2	32.8	27.0	24.4	28.8	36.5	43.7
Ave. Minimum Temp (°F)	33.5	24.9	20.4	17.3	19.3	24.4	29.9
Absolute Min. Temp (°F)	20	-4	0	-19	-6	-11	12
No. of days with Freezing Temp.	15	22	28	26	28	20	19
Precipitation (water equivalent) (in)	0.09	1.68	0.91	2.28	0.48	0.88	0.71
Snowfall Amount (in)	0.0	9.2	16.3	31.1	7.6	13.1	T
Snow on the Ground (in)	0	7	4	12	7	10	0

Fernie, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	47.2	31.3	23.4	19.0	25.1	31.7	40.0
Ave. Minimum Temp (°F)	37.0	25.0	17.3	12.2	15.6	22.3	30.3
Absolute Min. Temp (°F)	24	1	-13	-24	-16	-7	15
No. of days with Freezing Temp.	12	23	27	28	28	24	19
Precipitation (water equivalent) (in)	1.71	7.74	7.70	8.35	2.45	3.84	1.59
Snowfall Amount (in)	0.0	20.0	58.6	68.5	24.5	18.0	1.8
Snow on the Ground (in)	0	6	--	42	37	--	0

Fortine, MT

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	47.8	31.8	25.4	23.1	27.8	34.7	41.5
Ave. Minimum Temp (°F)	33.0	23.9	18.1	15.9	18.0	22.2	28.3
Absolute Min. Temp (°F)	19	8	-6	-22	-10	-10	10
No. of days with Freezing Temp.	16	26	30	30	28	28	19
Precipitation (water equivalent) (in)	0.14	1.74	0.7	2.22	0.25	0.66	1.02
Snowfall Amount (in)	0.0	7.8	4.5	28.3	4.0	2.5	0.5
Snow on the Ground (in)	0	6	4	14	8	5	0

Grasmere, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	47.5	32.8	27.7	24.0	31.3	37.7	41.8
Ave. Minimum Temp (°F)	33.0	25.2	22.1	18.0	23.1	27.2	29.5
Absolute Min. Temp (°F)	25	12	2	-16	6	-1	13
No. of days with Freezing Temp.	17	--	28	28	28	--	19
Precipitation (water equivalent) (in)	--	--	--	2.55	--	0.54	0.86
Snowfall Amount (in)	0.0	--	--	24.5	--	3.5	0.0
Snow on the Ground (in)	0	5	2	13	10	--	0

Kimberley, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	46.0	29.8	22.8	19.6	26.0	31.2	39.7
Ave. Minimum Temp (°F)	36.5	23.5	16.4	12.8	18.3	22.6	29.9
Absolute Min. Temp (°F)	28	7	-2	-8	0	3	12
No. of days with Freezing Temp.	6	27	30	31	28	28	20
Precipitation (water equivalent) (in)	0.96	2.67	5.37	4.03	1.27	2.44	1.14
Snowfall Amount (in)	0.0	25.2	53.1	39.3	12.7	17.6	3.1
Snow on the Ground (in)	0	--	28	(>12)	(>6)	0	0

Kootenay, N.P. (West Gate) BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	43.4	28.3	19.6	16.5	24.4	32.6	40.5
Ave. Minimum Temp (°F)	33.5	22.6	13.6	9.7	15.7	22.1	29.3
Absolute Min. Temp (°F)	25	-1	-3	-13	-2	-1	20
No. of days with Freezing Temp.	16	26	30	30	28	28	24
Precipitation (water equivalent) (in)	0.91	1.86	1.92	2.30	0.40	0.53	0.90
Snowfall Amount (in)	0.0	14.7	19.2	23.0	4.0	3.3	2.2
Snow on the Ground (in)	0	4	13	20	18	0	0

Libby 1NE, MT

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	47.6	35.1	28.3	26.5	31.8	35.8	44.9
Ave. Minimum Temp (°F)	34.0	27.9	23.0	19.7	22.1	22.8	29.4
Absolute Min. Temp (°F)	24	11	7	-1	6	-1	12
No. of days with Freezing Temp.	14	21	26	30	28	28	22
Precipitation (water equivalent) (in)	0.35	1.88	2.19	3.34	1.31	1.50	0.64
Snowfall Amount (in)	0.0	5.1	14.9	36.0	13.2	4.6	T
Snow on the Ground (in)	0	4	10	30	25	19	0

Natal Kaiser Resources, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	45.4	28.2	21.0	15.4	22.7	31.5	37.7
Ave. Minimum Temp (°F)	33.1	19.9	13.6	7.8	11.3	20.4	26.7
Absolute Min. Temp (°F)	18	-5	-13	-32	-16	-12	8
No. of days with Freezing Temp.	16	24	29	30	28	27	26
Precipitation (water equivalent) (in)	0.93	2.87	5.23	5.13	0.97	2.51	2.46
Snowfall Amount (in)	0.0	9.7	42.0	42.5	9.7	12.7	5.4
Snow on the Ground (in)	0	--	--	--	--	--	0

WASA, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)							
Ave. Minimum Temp (°F)							
Absolute Min. Temp (°F)							
No. of days with Freezing Temp.							
Precipitation (water equivalent) (in)	--	1.83	1.32	--	0.20	0.18	1.00
Snowfall Amount (in)	0.0	14.0	13.0	--	2.0	0.8	1.6
Snow on the Ground (in)	0	4	6	--	8	0	0

Wycliffe, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	44.0	27.9	20.2	--	22.1	30.6	--
Ave. Minimum Temp (°F)	30.5	20.2	12.1	--	9.6	18.7	--
Absolute Min. Temp (°F)	21	-8	-13	--	-13	1	--
No. of days with Freezing Temp.	22	29	30	31	28	31	--
Precipitation (water equivalent) (in)	--	1.09	4.32	--	--	1.17	--
Snowfall Amount (in)	0.0	6.1	40.5	--	--	10.0	--
Snow on the Ground (in)	0	3	--	21	--	00	--

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Aberfeldie, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	44.8	33.0	17.3	26.4	28.8	29.0	46.6
Ave. Minimum Temp (°F)	33.4	28.3	11.9	20.3	20.7	17.8	35.2
Absolute Min. Temp (°F)	22	12	-24	0	0	-3	26
No. of days with Freezing Temp.	16	23	31	31	21	30	9
Precipitation (water equivalent) (in)	0.87	2.94	5.58	1.68	2.20	0.17	2.54
Snowfall Amount (in)	0.3	10.7	48.7	10.8	8.1	1.7	0.0
Snow on the Ground (in)	0	--	26	--	--	--	0

Canal Flats, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	--	30.8	11.5	20.9	24.8	28.6	46.6
Ave. Minimum Temp (°F)	--	25.0	4.7	12.5	14.9	17.1	33.5
Absolute Min. Temp (°F)	--	10	-28	-12	-5	-2	23
No. of days with Freezing Temp.	--	26	31	31	24	30	14
Precipitation (water equivalent) (in)	--	1.58	1.45	2.18	--	--	--
Snowfall Amount (in)	--	5.8	14.5	21.8	--	--	0.0
Snow on the Ground (in)	--	--	--	--	--	--	0

Cranbrook, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	41.9	29.8	13.1	22.6	26.2	26.0	44.1
Ave. Minimum Temp (°F)	28.5	22.5	5.5	14.6	16.7	13.4	31.1
Absolute Min. Temp (°F)	15	1	-30	-6	-5	-8	22
No. of days with Freezing Temp.	24	27	31	31	22	31	18
Precipitation (water equivalent) (in)	0.18	2.16	6.19	1.99	1.54	0.23	1.39
Snowfall Amount (in)	0.5	10.9	58.4	19.1	6.6	2.3	2.5
Snow on the Ground (in)	--	5	27	12	--	--	0

Elko, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	44.1	31.6	15.9	27.1	27.9	27.4	45.2
Ave. Minimum Temp (°F)	33.7	26.9	10.5	21.5	20.0	16.3	34.0
Absolute Min. Temp (°F)	22	11	-27	4	0	-4	26
No. of days with Freezing Temp.	14	23	31	31	21	30	13
Precipitation (water equivalent) (in)	0.84	3.96	4.89	1.63	1.76	--	1.21
Snowfall Amount (in)	1.8	9.7	46.1	14.5	10.6	--	1.5
Snow on the Ground (in)	0	--	--	--	--	--	0

Eureka, MT (Ranger Sta)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	44.7	33.0	17.2	29.6	28.5	29.2	46.6
Ave. Minimum Temp (°F)	31.3	26.5	10.4	23.6	19.8	15.2	32.6
Absolute Min. Temp (°F)	18	3	-27	7	-8	-11	22
No. of days with Freezing Temp.	19	24	30	27	21	31	14
Precipitation (water equivalent) (in)	0.77	1.39	3.62	0.96	0.91	0.58	2.16
Snowfall Amount (in)	1.5	10.3	44.4	14.2	8.1	5.7	3.9
Snow on the Ground (in)	0	3	22	20	7	2	1

Fernie, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	43.4	30.9	14.1	26.8	25.4	23.6	42.6
Ave. Minimum Temp (°F)	33.0	26.0	7.7	21.7	17.8	11.9	31.7
Absolute Min. Temp (°F)	22	5	-32	3	-14	-10	19
No. of days with Freezing Temp.	17	20	30	29	21	31	14
Precipitation (water equivalent) (in)	2.10	7.64	8.80	5.22	8.21	0.53	2.89
Snowfall Amount (in)	1.5	21.0	88.0	48.0	24.5	3.8	7.0
Snow on the Ground (in)	0	10	--	--	--	--	0

Fortine, MT

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	43.4	30.7	16.4	27.4	27.5	27.2	44.6
Ave. Minimum Temp (°F)	29.4	22.8	9.0	21.0	17.6	12.8	31.4
Absolute Min. Temp (°F)	18	-3	-23	0	-10	-8	19
No. of days with Freezing Temp.	21	26	30	29	24	31	15
Precipitation (water equivalent) (in)	1.26	2.17	3.28	1.14	0.89	0.26	1.45
Snowfall Amount (in)	1.0	9.8	31.3	9.0	0.5	0.3	1.5
Snow on the Ground (in)	0	4	21	18	14	3	0

Grasmere, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	43.6	33.1	19.3	29.9	29.3	28.0	46.6
Ave. Minimum Temp (°F)	31.1	26.9	14.0	25.2	21.0	16.0	34.5
Absolute Min. Temp (°F)	23	7	-28	8	-7	-7	25
No. of days with Freezing Temp.	19	23	28	28	24	31	12
Precipitation (water equivalent) (in)	0.97	2.26	3.98	0.65	1.72	0.10	1.87
Snowfall Amount (in)	1.5	6.0	32.5	4.0	6.5	1.0	3.0
Snow on the Ground (in)	0	4	24	16	10	0	0

Kimberley, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	--	29.5	14.1	23.6	24.9	25.6	43.7
Ave. Minimum Temp (°F)	--	24.1	7.6	17.5	16.9	15.4	33.6
Absolute Min. Temp (°F)	--	6	-23	1	-2	-6	25
No. of days with Freezing Temp.	--	24	31	31	26	30	10
Precipitation (water equivalent) (in)	--	--	4.24	4.01	2.62	1.21	1.09
Snowfall Amount (in)	--	--	42.4	40.1	21.6	12.1	1.8
Snow on the Ground (in)	--	14	30	--	38	14	0

Libby 1NE, MT

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	45.3	33.7	20.8	28.2	31.3	30.0	47.0
Ave. Minimum Temp (°F)	33.5	27.6	14.4	21.6	20.9	13.8	29.9
Absolute Min. Temp (°F)	25	12	-28	4	0	-8	20
No. of days with Freezing Temp.	15	25	31	31	27	31	21
Precipitation (water equivalent) (in)	1.02	2.72	5.03	2.20	1.31	0.39	2.04
Snowfall Amount (in)	0.0	7.1	45.4	20.5	5.1	6.5	--
Snow on the Ground (in)	0	3	30	36	17	15	2

WASA, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	--						
Ave. Minimum Temp (°F)	--						
Absolute Min. Temp (°F)	--						
No. of days with Freezing Temp.	--						
Precipitation (water equivalent) (in)	--	0.80	2.70	0.44	--	0.40	0.68
Snowfall Amount (in)	--	8.0	27.0	4.0	--	4.0	0.0
Snow on the Ground (in)	--	4	18	15	0	--	0

Wycliffe, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (°F)	40.7	28.1	12.6	19.4	23.4	23.5	42.5
Ave. Minimum Temp (°F)	26.9	20.1	4.8	10.0	12.0	9.8	29.0
Absolute Min. Temp (°F)	14	-4	-35	-11	-13	-13	21
No. of days with Freezing Temp.	28	27	31	31	25	31	25
Precipitation (water equivalent) (in)	0.27	1.31	3.77	1.62	1.29	0.39	0.85
Snowfall Amount (in)	1.0	10.4	37.7	16.2	6.4	3.9	2.1
Snow on the Ground (in)	0	6	23	23	14	4	0

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Aberfeldie, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (^oF)	48.0	34.7	22.5	27.9	29.4	31.5	42.4
Ave. Minimum Temp (^oF)	37.7	28.7	17.5	22.5	19.7	23.1	33.3
Absolute Min. Temp (^oF)	25	2	1	5	8	-3	23
No. of days with Freezing Temp.	8	17	30	30	28	28	13
Precipitation (water equivalent) (in)	0.79	2.17	2.57	3.51	0.61	1.24	2.87
Snowfall Amount (in)	0.0	5.2	16.0	24.6	4.0	7.6	2.0
Snow on the Ground (in)	0	0	--	--	3	--	0

Canal Flats, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (^oF)	--	--	19.7	21.8	24.9	30.3	42.3
Ave. Minimum Temp (^oF)	--	--	12.8	14.2	14.2	21.0	32.0
Absolute Min. Temp (^oF)	--	--	-7	-6	4	-3	21
No. of days with Freezing Temp.	--	--	29	30	28	29	17
Precipitation (water equivalent) (in)	--	--	--	2.07	0.20	0.63	1.62
Snowfall Amount (in)	--	--	--	17.0	2.0	6.3	4.0
Snow on the Ground (in)	--	--	--	--	--	--	0

Cranbrook, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (^oF)	45.8	31.2	18.6	24.3	25.3	29.3	41.1
Ave. Minimum Temp (^oF)	33.8	23.7	12.1	17.2	13.4	19.3	30.4
Absolute Min. Temp (^oF)	20	-4	-10	-2	2	-6	17
No. of days with Freezing Temp.	15	25	30	30	29	30	19
Precipitation (water equivalent) (in)	0.59	2.10	1.65	3.23	0.29	1.06	1.00
Snowfall Amount (in)	T	10.1	15.5	31.7	2.0	10.3	3.2
Snow on the Ground (in)	0	--	--	8	1	0	0

Elko, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (^oF)	47.6	33.8	21.7	27.3	28.3	30.1	41.4
Ave. Minimum Temp (^oF)	37.4	27.8	16.5	22.6	18.6	22.3	32.4
Absolute Min. Temp (^oF)	26	2	-4	4	8	-5	22
No. of days with Freezing Temp.	7	17	31	30	28	30	12
Precipitation (water equivalent) (in)	1.04	1.59	2.16	3.64	0.43	1.77	2.27
Snowfall Amount (in)	T	9.1	17.8	33.0	2.4	14.9	4.5
Snow on the Ground (in)	0	0	--	--	--	--	0

Eureka, MT (Ranger Sta)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (^oF)	48.2	35.8	21.6	29.8	32.0	32.3	44.4
Ave. Minimum Temp (^oF)	34.9	28.2	15.8	24.6	21.9	22.8	32.5
Absolute Min. Temp (^oF)	21	5	-10	8	10	-6	19
No. of days with Freezing Temp.	12	16	31	29	27	29	13
Precipitation (water equivalent) (in)	0.88	0.92	1.55	1.14	0.30	2.08	0.70
Snowfall Amount (in)	0.0	4.9	15.9	17.4	1.2	25.5	3.5
Snow on the Ground (in)	0	3	9	7	1	12	1

Fernie, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (^oF)	45.7	33.6	21.7	25.9	27.7	28.0	38.9
Ave. Minimum Temp (^oF)	35.8	29.0	16.6	21.3	19.4	20.3	30.2
Absolute Min. Temp (^oF)	24	--	-7	-5	4	-10	18
No. of days with Freezing Temp.	10	18	29	30	27	30	18
Precipitation (water equivalent) (in)	--	--	--	--	--	--	--
Snowfall Amount (in)	--	--	--	--	--	--	--
Snow on the Ground (in)	--	0	9	--	--	25	0

Fortine, MT

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (^oF)	46.6	33.8	21.2	27.3	28.2	29.6	41.2
Ave. Minimum Temp (^oF)	32.1	26.1	14.3	21.1	16.8	19.2	29.2
Absolute Min. Temp (^oF)	22	6	-12	-4	3	-7	15
No. of days with Freezing Temp.	19	23	31	31	29	31	20
Precipitation (water equivalent) (in)	0.92	1.19	1.59	1.12	0.14	1.63	0.96
Snowfall Amount (in)	0.0	6.9	14.6	11.0	0.5	14.5	4.4
Snow on the Ground (in)	0	4	9	9	7	9	2

Grasmere, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (^oF)	--	34.1	23.4	30.1	30.4	31.4	42.7
Ave. Minimum Temp (^oF)	36.5	28.0	18.4	23.9	21.1	22.5	32.8
Absolute Min. Temp (^oF)	24	--	-5	7	10	-2	15
No. of days with Freezing Temp.	11	29	29	29	27	30	12
Precipitation (water equivalent) (in)	0.49	--	2.26	--	0.07	1.92	2.92
Snowfall Amount (in)	0.0	--	14.8	--	0.7	12.0	18.5
Snow on the Ground (in)	0	0	6	10	8	6	0

Kimberley, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (^oF)	--	30.2	19.2	22.5	25.6	26.7	38.7
Ave. Minimum Temp (^oF)	--	23.8	13.0	15.6	16.0	17.3	29.7
Absolute Min. Temp (^oF)	20	-4	-13	5	9	-10	16
No. of days with Freezing Temp.	--	28	31	31	29	30	21
Precipitation (water equivalent) (in)	0.96	3.88	1.55	4.59	1.04	2.37	1.89
Snowfall Amount (in)	0.5	27.5	15.5	44.9	9.5	23.7	7.8
Snow on the Ground (in)	0	0	12	29	23	22	0

Libby Dam, MT

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (^oF)	48.8	36.0	24.8	29.5	31.7	34.3	44.1
Ave. Minimum Temp (^oF)	35.6	30.5	18.1	22.7	18.6	23.1	29.3
Absolute Min. Temp (^oF)	22	20	-12	10	8	3	17
No. of days with Freezing Temp.	9	17	31	31	29	31	21
Precipitation (water equivalent) (in)	1.35	2.70	1.5	2.87	0.64	1.10	0.41
Snowfall Amount (in)	0.0	1.0	6.4	36.8	T	T	0.0
Snow on the Ground (in)	0	--	10	28	19	11	0

WASA, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (^oF)							
Ave. Minimum Temp (^oF)							
Absolute Min. Temp (^oF)							
No. of days with Freezing Temp.							
Precipitation (water equivalent) (in)	0.39	--	--	0.22	--	--	2.10
Snowfall Amount (in)	0.0	--	--	1.0	--	--	6.8
Snow on the Ground (in)	0	--	--	--	--	--	0

Wycliffe, BC

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Ave. Temperature (^oF)	44.0	29.0	17.0	21.6	21.5	26.5	38.9
Ave. Minimum Temp (^oF)	30.7	20.9	9.5	13.0	7.3	14.8	27.4
Absolute Min. Temp (^oF)	18	-9	-15	-9	-5	-14	17
No. of days with Freezing Temp.	18	28	31	31	29	31	26
Precipitation (water equivalent) (in)	0.67	1.97	1.30	2.49	--	0.52	0.75
Snowfall Amount (in)	T	9.5	13.0	24.8	--	4.4	2.9
Snow on the Ground (in)	0	T	--	18	--	14	0

APPENDIX II A

SUMMATION OF AVERAGE MONTHLY TEMPERATURES
(Period of Record 1963-1973)

	Oct.	Nov.	Dec.	Jan.*	Feb.	Mar.	Apr.	Σ of ≤ 32°F
Libby, Mt.	44.6	34.0	23.5	22.9	30.9	35.9	43.9	576
Eureka, Mt.	43.0	33.4	22.2	22.8	29.9	36.3	44.9	648
Elko, B.C.	43.2	32.0	21.2	18.1	28.3	33.4	42.2	869
Aberfeldie, B.C.	43.3	32.9	21.7	20.6	29.1	35.8	43.2	754
Kimberley, B.C.	40.8	29.7	18.4	17.6	25.8	30.6	39.7	1154
Canal Flats, B.C.	42.2	31.0	18.0	16.2	25.5	33.8	43.1	1136
Kootenay, B.C.	40.2	28.8	17.2	15.2	25.0	33.9	41.5	1271

*Temperature data for B.C. stations during Jan. 1968 missing.

APPENDIX II B

AVERAGE MONTHLY AIR TEMPERATURES FOR COLDEST WINTER BETWEEN 1963-1973

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	Σ of ≤ 32°F
Libby, Mt. (1968-69)	43.3	34.7	19.9	14.6	28.9	37.1	47.9	1001
Eureka, Mt. (1968-69)	41.0	33.2	17.2	10.4	23.9	37.3	52.3	1355
Elko, B.C. (1968-69)	42.5	32.6	16.4	7.6	23.8	34.2	46.4	1470
Aberfeldie, B.C. (1968-69)	43.2	34.4	16.9	7.7	23.9	34.9	46.0	1448
Kimberley, B.C. (1968-69)	40.3	29.3	13.8	6.3	23.1	32.6	43.3	1691
Canal Flats, B.C. (1968-69)	43.0	32.1	14.9	1.1	19.5	33.0	46.7	1838
**Kootenay (2nd coldest) (1971-72), B.C.	38.6	30.1	9.2	8.3	21.6	35.6	40.1	1790

**1968-69 - Dec. and Jan. missing.

APPENDIX III

Summation of Monthly Snowfall Amounts and Maximum Snow on the Ground (inches)

Libby Dam and Libby 1-NE, Montana

	Oct.		Nov.		Dec.		Jan.		Feb.		Mar.		Apr.	
	SF*	SOG*	SF	SOG	SF	SOG	SF	SOG	SF	SOG	SF	SOG	SF	SOG
1972-73	-	-	-	-	-	-	-	-	-	-	-	-	-	-
71-72	-	-	-	-	37.8	16	23.3	19	3.5	18	2.0	12	T	0
70-71	T	0	10.5	7	35.0	17	29.4	31	4.4	12	9.0	8	0	0
69-70	0	0	-	-	12.1	9	27.5	20	1.0	17	6.1	17	0	0
68-69	0	0	6.8	5	28.8	19	51.5	34	1.8	32	T	21	0	0
67-68	0	0	5.0	-	-	-	22.5	13	1.0	12	0	0	0	0
66-67	T	0	7.5	4	15.6	6	30.0	23	2.6	4	0	1	0	0
65-66	0	0	5.1	4	14.9	10	36.0	30	13.2	25	4.6	19	T	0
64-65	0	0	7.1	3	45.4	30	20.5	36	5.1	17	6.5	15	0	2
63-64	0	0	1.0	-	6.4	10	36.8	28	T	19	T	11	0	0
Averages	T	0	6.1	4	24.5	15	30.8	26	3.6	17	3.1	16	T	0

1. Average Annual Snowfall amount = 68.1 inches.
2. Maximum Annual Snowfall amount = 88.9 inches (1968-69); 88.3 inches (1970-71)
3. Minimum Annual Snowfall amount = 44.2 inches (1963-64).
4. Maximum Monthly Snowfall amount = 51.5 inches (Jan. 1969).
5. Highest Monthly Average Snow on the Ground = 26 inches (Jan.)
6. Highest Maximum Snow on the Ground = 36 inches (Jan. 1965).

SF* = Snowfall amounts; SOG* = Depth of Snow on the Ground

APPENDIX III (Cont'd)

Summation of Monthly Snowfall Amounts And Maximum Snow on the Ground (inches)

Fortine, Montana

	Oct.		Nov.		Dec.		Jan.		Feb.		Mar.		Apr.	
	SF*	SOG*	SF	SOG	SF	SOG	SF	SOG	SF	SOG	SF	SOG	SF	SOG
1972-73	10.0	3	5.0	3	8.5	6	4.5	5	5.5	5	1.0	0	T	0
1971-72	2.5	2	5.0	2	19.5	9	34.0	18	40.0	16	5.0	2	3.0	T
1970-71	T	0	14.5	7	13.5	10	22.5	16	3.0	3	12.0	3	T	0
1969-70	3.0	1	5.0	5	9.8	5	21.5	12	5.5	12	6.5	10	T	0
1968-69	0	0	3.0	1	22.5	14	37.0	28	10.0	28	1.0	20	T	0
1967-68	0	0	2.0	1	-	-	7.0	5	2.5	5	2.0	2	1.0	T
1966-67	0.5	T	9.5	6	10.5	8	4.0	2	4.5	4	10.5	4	0.5	T
1965-66	0	0	7.8	6	4.5	4	28.3	14	4.0	8	2.5	5	0.5	0
1964-65	1.0	0	9.8	4	31.3	21	9.0	18	0.5	14	0.3	3	1.5	0
1963-64	0	0	6.9	4	14.6	9	11.0	9	0.5	7	14.5	9	4.4	2
Averages	1.7	1	6.9	4	15.0	10	17.9	13	7.6	10	5.5	6	1.1	0

1. Average Annual Snowfall amount = 55.7 inches
2. Maximum Annual Snowfall amount = 109.0 (1971-1972)
3. Minimum Annual Snowfall amount = 34.5 (1972-1973)
4. Maximum Monthly Snowfall amount = 40.0 (Feb. 1972)
5. Highest Monthly Average Snow on the Ground = 13.0 (Jan.)
6. Highest Maximum Snow on the Ground = 28.0 (Jan. and Feb. 1969)

APPENDIX III (Cont'd)

Summation of Monthly Snowfall Amounts
And Maximum Snow on the Ground (inches)

Eureka, Montana

	Oct.		Nov.		Dec.		Jan.		Feb.		Mar.		Apr.	
	SF*	SOG*	SF	SOG	SF	SOG	SF	SOG	SF	SOG	SF	SOG	SF	SOG
1972-73	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1971-72	-	-	3.5	2	47.5	-	31.0	-	-	-	-	-	16.0	3
1970-71	0	0	-	-	10.0	-	-	-	-	-	6.5	-	-	-
1969-70	C	0	1.0	0	-	-	-	-	-	-	8.5	-	0	0
1968-69	-	-	-	-	20.5	-	47.5	-	1.5	-	3.0	-	0	0
1967-68	0	-	T	0	-	-	15.0	12	1.0	4	1.0	1	0	0
1966-67	0.8	0	10.7	4	11.7	7	5.3	1	6.3	4	13.6	3	1.8	0
1965-66	0	0	9.2	7	16.3	4	31.1	12	7.6	7	13.1	10	T	0
1964-65	1.5	0	10.3	3	44.4	22	14.2	20	8.1	7	5.7	2	3.9	1
1963-64	0	0	4.9	3	15.5	9	17.4	7	1.2	1	25.5	12	3.5	1
Averages	0.3	0	5.6	3	23.7	10	23.0	10	4.3	5	9.6	6	3.1	1

1. Average Annual Snowfall amount = 69.6 inches
2. Maximum Annual Snowfall amount = 98.0 (1971-1972)
3. Minimum Annual Snowfall amount = 50.2 (1966-1967)
4. Maximum Monthly Snowfall amount = 47.5 (Dec. 1971 and Jan. 1969)
5. Highest Monthly Average Snow on the Ground = 10.0 (Dec. and Jan.)
6. Highest Maximum Snow on the Ground = 22.0 (Dec. 1964)

SF* = Snowfall amounts; SOG* = Depth of Snow on the Ground

APPENDIX III (Cont'd)

Summation of Monthly Snowfall Amounts
And End of Month Depth of Snow on the Ground (inches)

Grasmere, B. C.

	Oct.		Nov.		Dec.		Jan.		Feb.		Mar.		Apr.	
	SF*	SOG*	SF	SOG	SF	SOG	SF	SOG	SF	SOG	SF	SOG	SF	SOG
1972-73	-	-	2.0	-	3.5	1	1.0	0	7.0	0	4.0	0	0	0
1971-72	8.3	3	4.0	2	15.7	12	12.0	18	T	5	1.5	0	-	-
1970-71	0	0	14.0	8	19.0	10	10.5	5	-	-	8.0	0	0	0
1969-70	2.5	0	0.5	0	9.0	8	5.0	11	5.0	12	7.0	0	T	0
1968-69	0	0	5.5	0	27.5	19	26.5	34	4.0	25	1.0	-	0	0
1967-68	0	0	0.5	T	11.2	-	-	-	2.5	0	2.0	0	0.2	0
1966-67	2.0	0	6.5	4	6.0	1	3.0	0	8.0	0	9.5	0	T	0
1965-66	0	0	-	5	-	2	24.5	13	-	10	3.5	-	0	0
1964-65	1.5	0	6.4	4	32.5	24	4.0	16	6.5	10	1.0	0	3.0	0
1963-64	0	0	-	0	14.8	6	-	10	0.7	8	12.0	6	18.5	0
Averages	1.6	0	4.9	3	15.4	9	10.8	12	4.2	8	5.0	1	2.4	0

1. Average Annual Snowfall amount = 44.3"
2. Maximum Annual Snowfall amount = 64.5" (1968-69)
3. Minimum Annual Snowfall amount = 29.0" (1969-70)
4. Maximum Monthly Snowfall amount = 32.5" (Dec. 1964)
5. Highest Average Monthly Depth of Snow on the Ground = 12" (Jan.)
6. Highest Maximum Monthly Depth of Snow on the Ground = 34" (Jan. 1969).

APPENDIX III (Cont'd)

Summation of Monthly Snowfall Amounts
And End of Month Depth of Snow on the Ground (inches)

Cranbrook, B. C.

	Oct.		Nov.		Dec.		Jan.		Feb.		Mar.		Apr.	
	SF*	SOG*	SF	SOG	SF	SOG	SF	SOG	SF	SOG	SF	SOG	SF	SOG
1972-73	7.1	2	2.5	T	7.7	3	9.2	2	12.4	2	4.8	0	2.2	0
1971-72	3.0	2	7.4	T	31.6	13	24.9	17	6.1	8	4.5	0	10.6	0
1970-71	0.5	0	16.5	7	24.9	13	32.4	11	5.2	5	10.0	T	0.8	0
1969-70	3.7	0	T	0	15.4	7	19.7	17	4.7	13	3.5	0	4.8	0
1968-69	0	0	11.9	2	41.9	13	39.6	29	7.8	24	4.9	3	-	-
1967-68	2.0	0	2.8	-	16.6	T	-	-	0.7	0	1.0	0	2.7	0
1966-67	2.3	0	16.5	-	7.1	-	17.3	-	7.2	-	19.1	-	1.1	0
1965-66	0	0	15.7	4	34.9	8	32.4	12	8.5	(1)	16.2	0	2.6	0
1964-65	0.5	-	10.9	5	58.4	27	19.1	12	6.6	0	2.3	0	2.5	0
1963-64	T	0	10.1	0	15.5	0	31.7	8	2.0	1	10.3	0	3.2	0
Averages	1.9	0	9.4	2	25.4	9	25.1	14	6.1	6	7.6	0	3.4	0

1. Average Annual Snowfall amount = 78.9"
2. Maximum Annual Snowfall amount = 110.3" (1965-66)
3. Minimum Annual Snowfall amount = 45.9" (1972-73)
4. Maximum Monthly Snowfall amount = 58.4" (Dec. 1964)
5. Highest Average Monthly Depth of Snow on the Ground = 14" Jan.
6. Highest Maximum Monthly Depth of Snow on the Ground = 29" (Jan. 1969)

SF* = Snowfall amount; SOG* = Depth of Snow on the Ground

APPENDIX III (Cont'd)

Summation of Monthly Snowfall Amounts
And End of Month Depth of Snow on the Ground (inches)

Kimberley, B. C.

	Oct.		Nov.		Dec.		Jan.		Feb.		Mar.		Apr.	
	SF*	SOG*	SF	SOG	SF	SOG	SF	SOG	SF	SOG	SF	SOG	SF	SOG
1972-73	10.0	-	6.0	3	34.7	19	30.6	24	16.4	22	9.9	8	5.2	-
1971-72	13.1	9	24.6	-	67.6	27	47.6	41	28.3	-	17.0	6	18.0	-
1970-71	0.4	0	17.4	-	61.9	28	57.3	31	13.9	30	27.4	27	T	0
1969-70	7.8	0	2.4	1	19.0	10	33.3	26	14.5	-	14.3	-	6.9	0
1968-69	T	0	22.9	12	52.9	31	49.9	36	21.5	38	14.7	19	7.1	-
1967-68	2.3	0	3.7	3	36.1	15	-	-	11.5	15	8.9	0	8.0	0
1966-67	2.2	0	31.2	2	23.6	2	36.0	-	7.0	18	28.0	20	0.5	0
1965-66	0	0	25.2	-	53.1	28	39.3	(>12)	12.7	(>6)	17.6	0	3.1	0
1964-65	-	-	-	14	42.4	30	40.1	-	21.6	38	12.1	14	1.8	0
1963-64	0.5	0	27.5	0	15.5	12	44.9	29	9.5	23	23.7	22	7.8	0
Averages	4.0	1	17.9	5	40.7	20	42.1	28	15.7	26	17.4	13	6.5	0

1. Average Annual Snowfall amount = 144.3"
2. Maximum Annual Snowfall amount = 216.2" (1971-72)
3. Minimum Annual Snowfall amount = 98.2" (1969-70)
4. Maximum Monthly Snowfall amount = 67.6" (Dec. 1971)
5. Highest Average Monthly Depth of Snow on the Ground = 28" (Jan.)
6. Highest Maximum Monthly Depth of Snow on the Ground = 41" (Jan. 1972)

APPENDIX III (Cont'd)

Summation of Monthly Snowfall Amounts
And End of Month Depth of Snow on the Ground (inches)

Wasa, B. C.

	Oct.		Nov.		Dec.		Jan.		Feb.		Mar.		Apr.	
	SF*	SOG*	SF	SOG	SF	SOG	SF	SOG	SF	SOG	SF	SOG	SF	SOG
1970-71	T	0	12.9	4	12.5	5	22.5	7	1.5	3	0	0	0	0
1969-70	1.8	0	0	0	6.4	4	15.8	10	5.9	-	2.2	-	4.1	0
1968-69	0	0	10.7	0	24.3	13	23.9	25	5.0	24	1.0	4	3.3	3
1967-68	1.0	0	0.5	0	9.0	2	-	-	0	0	0.1	0	2.6	0
1966-67	T	0	10.6	-	3.0	-	7.0	-	0.6	0	8.7	0	0	0
1965-66	0	0	14.4	4	13.0	6	-	-	2.0	8	0.8	0	1.6	0
1964-65	-	-	8.0	4	27.0	18	4.0	15	-	0	4.0	-	0	0
1963-64	0	0	-	-	-	-	1.0	-	-	-	-	-	6.8	0
Averages	0.4	0	8.2	2	13.6	8	12.4	14	2.5	12	2.4	1	2.3	0

1. Average Annual Snowfall amount = 41.8"
2. Maximum Annual Snowfall amount = 68.2" (1968-69)
3. Minimum Annual Snowfall amount = 29.9" (1966-67)
4. Maximum Monthly Snowfall amount = 27.0" (Dec. 1964)
5. Highest Average Monthly Depth of Snow on the Ground = 14" (Jan.)
6. Highest Maximum Monthly Depth of Snow on the Ground = 25" (Jan. 1969)

SF* = Snowfall amount; SOG* = Depth of Snow on the Ground

APPENDIX III (Cont'd)

Summation of Monthly Snowfall Amounts
And End of Month Depth of Snow on the Ground (inches)

Kootenay National Park (West Gate and Administration), B. C.

	Oct.		Nov.		Dec.		Jan.		Feb.		Mar.		Apr.	
	SF*	SOG*	SF	SOG	SF	SOG	SF	SOG	SF	SOG	SF	SOG	SF	SOG
1972-73	0.8	-	1.5	-	12.2	7	4.0	7	5.1	7	6.0	-	0.6	0
1971-72	6.5	5	3.5	0	31.8	22	21.0	27	19.4	32	7.2	1	0	0
1970-71	T	0	10.6	6	12.4	12	17.9	15	3.0	13	4.8	5	0	0
1969-70	1.4	0	T	0	4.6	3	19.7	14	5.3	14	1.5	0	T	0
1968-69	0	0	2.5	1	-	-	15.2	24	6.7	24	1.0	0	T	0
1967-68	0.4	0	6.5	4	13.6	9	-	-	3.2	0	5.3	-	19.0	0
1966-67	6.1	0	17.2	4	7.2	3	20.1	8	7.5	9	6.7	1	0.9	0
1965-66	0	0	14.7	4	19.2	13	23.0	20	4.0	18	3.3	0	2.2	0
Averages	1.9	1	7.1	3	14.4	10	17.2	13	6.8	15	4.5	1	2.8	0

1. Average Annual Snowfall amount = 54.7"
2. Maximum Annual Snowfall amount = 89.4" (1971-72)
3. Minimum Annual Snowfall amount = 30.2" (1972-73)
4. Maximum Monthly Snowfall amount = 31.8" (Dec. 1971)
5. Highest Average Monthly Depth of Snow on the Ground = 15" (Feb.)
6. Highest Maximum Monthly Depth of Snow on the Ground = 32" (Feb. 1972)